

Training

CAP MODEL ROCKETRY PROGRAM

This manual establishes model rocketry as an authorized activity in the Civil Air Patrol (CAP) cadet program (extracurricular). Cadet volunteer activities in model rocketry will supplement and enrich aerospace education now presented in Phase II training. Cadets who desire to take part in model rocketry activities, and who are in Phase II, may do so as an additional supervised project.

1. Terms Explained. In keeping with the safe practices that must be observed by all CAP cadets and senior member supervisors who are about to engage in model rocketry activities, three terms need to be explained:

a. "Model rocketry" is the designing, building, and flying of small rockets that are made of paper, plastic, balsa wood, or any other nonmetallic product (model rockets constructed in this manner are approved for use by CAP members).

b. "Model rocket engines" are solid propellant engines that are made by commercial manufacturers and intended for use in model rockets of the construction described in paragraph a above. The manufacturer furnishes these "safe" engines ready for use (this type engine is the only type approved for use by CAP members). There is no need for the rocketeer to mix potentially dangerous chemical ingredients.

c. "Amateur rocketeer" is the term used to describe those inexperienced individuals who engage in unsupervised rocketry experimentation in which metallic airframes and homemade propellants are used. This type of experimentation is extremely dangerous and is **not** to be practiced in CAP model rocketry activities.

2. Objectives. The model rocketry program for CAP cadets is designed to:

a. Acquaint CAP cadets with the importance of rocketry and its role in the future.

b. Increase cadets' knowledge of aerospace sciences and motivate them to attain an even greater knowledge of aerospace sciences.

c. Employ an interest in model rocketry to enrich the total development of CAP cadets.

d. Provide activities and opportunities for the development of aerospace leadership skills.

e. Arouse interest in aerospace careers that require a knowledge of rocketry.

f. Contribute to the development of an understanding of aerospace power.

g. Lead to the discovery of the individual educational needs of cadets aspiring to careers in aerospace.

3. Establishing the Model Rocketry Program. Each unit commander will:

a. Identify qualified cadets who are interested in participating in the CAP model rocketry program.

b. Provide interested cadets with an overview of the model rocketry program, including its objectives, requirements, and awards.

c. If warranted by cadet interest, establish a model rocketry program for the unit in accordance with the directives and guidelines provided in this manual.

4. Program Development. The degree to which units develop their model rocketry program will depend upon their interest, time, and resources. Activities range from a basic program to an advanced program involving the use of computers. Model rocketry instructors may develop expertise in the subject matter through individual reading or through aerospace education workshops on model rocketry (see paragraph 6a). It is suggested that model rocketry program development planners design a BASIC MODEL ROCKETRY PROGRAM and ADVANCED MODEL, ROCKETRY PROGRAMS. Within and across these two major divisions of programs, the rocketry program designer should structure the skill and experience in designing, building, and flying successful model rockets in five stages, or levels as follows:

BASIC MODEL ROCKETRY PROGRAM

Level 1: Very Simple. This is the *beginners* level.

Level 2: Fairly Easy. This is for persons with *some* model rocket construction *experience*.

ADVANCED MODEL ROCKETRY PROGRAMS

Level 3: Intermediate. This is for the experienced model rocket builder and flyer.

Level 4: Challenging. This is for the *advanced* model rocket builder and flyer.

Level 5: Extremely Challenging. This is recommended for the *expert* model rocket builder and flyer. These skill levels should be implemented in the order given above for safety reasons and for sound learning results.

a. Basic Program. Develop a unit plan to conduct the basic model rocketry program and to provide the completion of the performance requirements (PRs) and the leadership requirements (LRs) listed in this manual.

(1) A 6-week model rocketry program is suggested as an initial activity. The meeting schedule shown in figure 1 is recommended, but may be changed as necessary to meet the particular requirements of individual CAP units. Figure 2 shows a suggested program for a 6-week program

Figure 1. Suggested Meeting Schedule for Model Rocketry Program

1900 to 1905	Opening Formation for Cadets
1905 to 1930	Leadership Laboratory
1930 to 1940	Opening Ceremonies
1940 to 2025	Classroom Work (Lectures on theory, design, etc.)
2025 to 2035	Break
2035 to 2120	Rocketry Laboratory (Construct rockets, launch equipment, etc.)
2120 to 2130	Closing Ceremonies

Figure 2. Suggested 6-week Program of Instruction in the Basics of Model Rocketry

Meeting No.	Classroom Period Activities	Laboratory Period Activities
1	<ul style="list-style-type: none"> a. Introduce basic model rocketry glossary. b. Discuss construction of body tubes, nose cones, and fins. c. Explain construction of commercial model rocket engines and their principles of operation. d. Present the Model Rocketry Safety Code. 	<ul style="list-style-type: none"> a. Demonstrate the tools and materials needed to construct a simple single-stage rocket. b. Demonstrate types of engines available (borrow from model shops). c. Provide lists of tools and materials needed to construct a single-stage rocket; provide plans for rocket.
2	<ul style="list-style-type: none"> a. Explain techniques of constructing recovery devices. b. Explain rocket aerodynamics and stability; demonstrate effects of CP and CG. 	Begin construction of single-stage rockets (all cadets use same basic plan).
3	<ul style="list-style-type: none"> a. Explain rocket ignition techniques. b. Explain paints and finishes suitable for rockets being constructed. c. Explain launching devices suitable for launching rockets being constructed. d. Decide which type launching device will be used in unit's first rocket launching activity. 	<ul style="list-style-type: none"> a. Continue construction of rockets. b. Begin construction of launching device from materials available; procure remainder of needed materials before next meeting.
4	<ul style="list-style-type: none"> a. Explain basic techniques of altitude determination and types of tracking devices. Decide which type tracking device will be used at unit rocket launching activity. b. Get volunteers to construct or obtain suitable tracking device. 	<ul style="list-style-type: none"> a. Complete construction of rockets. b. Continue construction of launching device.
5	<ul style="list-style-type: none"> a. Plan rocket launching activity. b. Make assignments (range officers, special details, etc.). c. Review safety code. 	<ul style="list-style-type: none"> a. Complete launching device and tracking device. b. Inspect completed model rockets.
6	Unit model rocket launching (conducted on a weekend).	

(2) To reinforce the introductory phase of the basic model rocketry program, units may obtain the new; 15-minute model rocketry movie *Model Rocketry: The Last Frontier* (color, 16mm sound). See attachment 3, Section II.H.2 for acquisition information. A filmstrip that may be used for this phase is Estes' filmstrip *Rockets!* (see attachment 3, Section II.H.1). *Rockets!* consists of over 100 frames with a 12-minute sound track cassette; the filmstrip introduces model rocketry quite well. It is also excellent for reviewing the safety rules of model rocketry on the day before a launch.

(3) There are a number of publications which are excellent reading aids to help the new rocketeer get started flying rockets. Consult attachment 3, Section I for annotated titles and publications.

b. Advanced Programs. Beyond the basic program in model rocketry, the possibilities for further rocket flight activities are almost unlimited. The degree of sophistication in engaging in model rocketry activities is limited only by one's imagination. Model rocketry is also an excellent vehicle for getting across various aspects and concepts of aerospace, that is, the Newtonian laws of motion. Skill levels 3 through 5 are involved in the advanced programs, and the rocketry instructor should develop a plan for completing each level.

(1) G. Harry Stine's *The Handbook of Model Rocketry, sixth edition* may continue to serve as a basic guide in advanced programs.

(2) Integrating model rocketry with other aerospace subjects. Model rocketry represents an excellent vehicle for learning other aerospace subjects. Subjects in themselves can become boring without an application. Attachment 3, Section II.A.1 through 4, 6, and 10 are excellent sources with which hands-on learning activities in model rocketry may be incorporated into mathematics and the study of manufacturing, transportation, Research & Development (R&D), communication, and construction.

(3) Projects. Students in the advanced program have the opportunity to plan, prepare, and present research projects. Ideas for these projects may be obtained from the sources listed in attachment 3, Section II.E. items 1 through 3. Of course, other publications in attachment 3, Section II also contain model rocket research projects.

(4) Model rocket history and rocket achievements. Somewhere in the advanced program, the students might want to look back at the history of model rocketry and also at the achievements of rockets for space missions. Items 8 and 9 of Section II.A. and Section II.D. in attachment 3 lists excellent sources.

(5) Discrete areas of model rocketry. Advanced programs present a challenge to students to dig deeper and more thoroughly into the vital components of model rocketry-in doing so, they learn more about the "big" rockets. Several aspects of model rocket operations are contained in the publications listed in attachment 3, Section II.A.7 and B.1 through 13. These discrete operations should be structured over Levels 1 to 3 according to their level of difficulty and relative safety factors.

(6) Visual Aids. The rocketry instructor may find many of the publications listed in attachment 3 include visual aids with the basic publication. *Rockets!* (attachment 3, Section II.H.) can be shown before major launches for safety reasons.

(7) Model rocketry clubs. Students should be encouraged to join model rocketry clubs to foster the sense of competition and togetherness. The model rocketry instructor may consult Estes' publication on clubs to get ideas on organizing and operating a model rocket club (attachment 3, Section II.A.5).

(8) Reporting journals and articles. Further reading and learning about model rocketry maybe obtained through a brief list in attachment 3, Section II.C. The *American Spacemodeling* of the NAR especially should be read frequently since it will contain the latest changes in the official world of model rocketry.

5. Prerequisites for Cadet Participation:

- a. All cadets participating in the model rocketry program must have completed Phase I training.
- b. Cadets who are in Phase II and desire to participate in the model rocketry program may do so as an additional activity, with permission of their squadron commander. However, cadets may not cut scheduled standard Phase II classes or laboratories to attend model rocketry classes or laboratories.

6. Administering the Model Rocketry Program. The model rocketry program will be conducted in accordance with the provisions of this manual and the standards, regulations, and rules published by the National Association of Rocketry (NAR) in the "United States Model Rocketry Sporting Code" (see attachment 1). The unit model rocketry program will provide for competitive meets which will be conducted in accordance with NAR procedures (see attachment 1). Competitive meets should be scheduled and announced at least two weeks in advance.

a. Rocketry Program Instructors. Particular attention should be given to the selection of instructional personnel. Although desirable, it is not necessary that model rocketry instructors be rocketry experts. However, before a unit model rocketry program is begun it should be decided how many instructors will be needed and enough time allowed for them to become knowledgeable in the specialties they will teach (construction, propulsion, tracking, etc.). Careful consideration should be given to using cadet instructors who are already members of rocket clubs (clubs which have been chartered by the NAR and operate according to the rules of NAR). Besides reading (see attachment 3) and experimenting, model rocketry instructors may gain knowledge and experience in model rocketry through aerospace education workshops in model rocketry offered by various agencies and organizations. Instructors might also join together, within a unit or across units, to form their own workshop led by an experienced model rocketeer. Estes Industries has a special kit for training model rocketry teachers called the Alpha II kit. This kit is specially designed for workshops on model rocketry and will enable participants to obtain a basic knowledge and skill in building model rockets. Attachment 3, Section 1.2 and 11.1. 1 contain information on acquiring the Alpha II kit.

b. Personnel Required to Supervise Model Rocket Launchings:

- (1) Individual model rocketry program activities that involve launchings (other than competitive meets) will be

conducted under the supervision of the following personnel:

- (a) Range Officer
- (b) Safety Officer

(2) The minimum personnel necessary to conduct a CAP model rocket competitive meet are as follows:

- (a) Range Officer
- (b) Safety Officer
- (c) Launch Supervisor
- (d) Spectator Control Officer
- (e) Range Guards
- (f) Observers and Trackers
- (g) Public Affairs Officer

(3) The responsibilities and eligibility requirements of personnel supervising a CAP model rocket competitive meet are as follows:

(a) Range Officers. They are in complete charge of the range. No action is taken without their direction. They give all orders and make all decisions. Their place should be at the control center. They must be recognized as NAR senior members (see paragraph 10 for establishing a NAR section and obtaining NAR senior membership).

(b) Safety Officers. They are responsible for checking all critical points of the operation in advance to make certain that safety regulations are followed. They are responsible for the instruction of all personnel in safety procedures. No launching will take place until the safety officer has given clearance to the range officer. They may be qualified cadets.

(c) Launch Supervisors. They are responsible for assuring that established procedures are followed at the launch site and for supervising the actual launching operation. They certify the launch area to be clear before launching begins.

(d) Spectator Control Officers. They are responsible for clearing the launch area of all personnel not assigned to specific posts. They see that personnel are a safe distance before they give clearance for launching to the range officer. This assignment may be handled by the safety officer.

(e) Range Guards. They are responsible for keeping passersby out of the area, scanning the sky for aircraft, and certifying to the range officer that it is safe to launch rockets.

(f) Observers and Trackers. They are responsible for tracking the path of the rocket, taking observations on the azimuth and angle of elevation at the peak of the trajectory, and reporting these data to the control center for plotting.

(g) Public Affairs Officers. They arrange for advance publicity about the meet and provide for newspaper, radio, television, and/or magazine coverage of the activities. They ensure that the rocketry program enjoys favorable public relations.

c. Rocket Launching Record. All cadets will keep a record of each of their rocket launchings, to include those rockets that are launched on an individual, group, or competitive basis. Records will be maintained on a "CAP Model Rocket Launching Data Sheet," an example of which is included in this manual at attachment 2 and which is authorized for local reproduction.

7. Model Rocketry Program Requirements:

a. Performance Requirements (PR). Cadets participating in the model rocketry program must satisfy the following requirements:

(1) PR 1. Construct, launch, and evaluate at least one model rocket suitable for the altitude or scale altitude competition described in attachment 1.

(2) PR 2. Construct, launch, and evaluate at least one model rocket suitable for the scale, plastic scale, or payload competition described in attachment 1.

(3) PR 3. Construct, launch, and evaluate at least one model rocket suitable for the drag race, parachute duration, or boost/guide duration competition described in attachment 1.

(4) PR 4. Construct, launch, and evaluate at least one model rocket suitable for the spot landing or research and development competition described in attachment 1.

(5) PR 5. Prepare a diagram of atypical model rocket launch site and flight area that complies with NAR regulations. This diagram may be as elaborate as desired, but it must include at least the following: (1) Launcher, (2) Model Rocket, (3) Igniter, and (4) Land Area Requirements.

(6) PR 6. Submit for evaluation a journal of all activities completed in the model rocketry program. The journal must indicate completion of the performance requirements listed above, and it must include a "CAP Model Rocket Launching Data Sheet" for each launching.

b. Leadership Requirements (LR). Cadets in the model rocketry program must achieve proficiency and become successful in model rocketry activities and competition to an extent that clearly demonstrates to the satisfaction of the unit commander that they have attained excellence in model rocketry program techniques. The following leadership requirements must be satisfied.

(1) LR 1. Demonstrate a knowledge of the CAP model rocketry program and its concepts and techniques by satisfactorily implementing, administering, supervising, and evaluating model rocketry activities.

(2) LR 2. Demonstrate a knowledge of the organization of CAP model rocketry program activities, including the personnel required, the skills necessary, and the job responsibilities of cadets and senior members in individual, group, and competitive rocketry activities.

(3) LR 3. Demonstrate a knowledge of the physical facilities required for all model rocketry operational activities, to include facilities for (1): storage, handling, launching, and recovering model rockets, (2) launching and safety precautions, and (3)

spectator's protection.

(4) **LR 4.** Demonstrate the leadership skills necessary to conduct an individual test, group test, and NAR-sanctioned model rocketry competitive meet.

(5) **LR 5.** Serve successfully in a minimum of three of the seven positions listed under paragraph 6b, one of which must be the position of safety officer.

(6) **LR 6.** Pass an oral examination covering the topics of model rocketry techniques, procedures, operations, and safety precautions.

8. Model Rocketry Safety Code. Each cadet in the Model Rocketry Program will promise to faithfully follow all the rules of safe conduct as established in the "United States Model Rocket Sporting Code" (see attachment 1). Regulations may differ, so be sure that model rocket product use is approved in your locale.

9. Model Rocketry Awards:

a. When the cadet has satisfactorily completed both the performance requirements and the leadership requirements, the Model Rocketry Badge will be awarded upon application at a cost announced in the CAP Bookstore catalog.

b. If a cadet has earned the Mitchell Award and has satisfactorily completed the requirements for the Model Rocketry Badge, a silver star for attachment to the Goddard Achievement Ribbon is authorized. This silver star may be obtained through the CAP Bookstore.

c. Cadets who satisfied the requirements in paragraph a and/or b above prior to the effective date of this manual are also eligible to receive the appropriate award.

10. Formation of NAR Model Rocketry Sections. Each squadron conducting the model rocketry program for cadets is encouraged to establish a NAR section. CAP units can then enter into competitive meets with other NAR units on section, area, regional, and national levels. Application for the establishment of a NAR Model Rocketry Section may be obtained from the National Association of Rocketry, 182 Madison Drive, Elizabeth, PA 15037.

OFFICIAL

JOHN T. MASSINGALE, JR., Col, USAF
Executive Director

Signed

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3 Attachments
1. NAR United States Model Rocketry Sporting Code
2. CAP Model Rocket Launching Data Sheet
3. Select Model Rocketry References and Sources

SUMMARY OF CHANGES

This revision reflects new learning/teaching references and sources for the model rocketry program and changes the NAR Model Rocketry Safety Code from the 1 November 1983 CAPM 50-20.

**NATIONAL ASSOCIATION OF ROCKETRY'S
"UNITED STATES MODEL ROCKETRY SPORTING CODE"**

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ABOUT THE SPORTING CODE

Model Rocketry is an activity that emphasizes safety, education, and sportsmanship. Competition modeling develops patience and skill and encourages creativity and innovation. The National Association of Rocketry provides support for competition modeling as an excellent means of encouraging these aspects of model rocketry, and thereby ensuring the continued advancement of the hobby.

The United States Model Rocket Sporting Code (the "Pink Book") provides a standard set of rules by which NAR members may compete with one another on the basis of skill, ability, and expertise. The Sporting Code is administered by the NAR Contest and Records Committee (the "Contest Board") through its Regional and National Chairmen. This 1985 revision of the 1979 Sporting Code includes all previous revisions and is effective as of the Contest Year beginning on July 1, 1985.

From time to time, the Contest Board may add or revise rules by publishing the changes in **American Spacemodeling**, along with the date on which they are to be effective. These rule changes should be clipped and saved in your copy of the Sporting Code, on the pages marked "Published Amendments to the Sporting Code." There are a number of occurrences that can result in changes to the rules; including action by the Contest Board, suggestions from the membership carrying the signatures of three NAR members, and decisions reached through the protest and appeals process described in Rule 12. Additionally, the Sporting Code Revisions Subcommittee and the Provisional Events Subcommittee work continually to improve the Sporting Code. Members who would like to contribute to the work performed by either of these subcommittees are welcome to contact the National Contest Board.

Since the rules of the Sporting Code cannot cover all possible eventualities of competition, disputes over the rules are to be expected. Whenever the rules prove insufficient, competitors can often reach a satisfactory resolution of a problem by exercising common sense, fair play, and sportsmanship. When necessary, interpretation of the rules may be made on the field by the Contest Jury. Serious disagreements can be resolved through the protest and appeals mechanism.

All NAR members are invited to join in sanctioned competition activity. Members who do not belong to a NAR section can obtain the name of a club in their area (or information on starting a new section) by writing to the NAR Section Activities Committee, in care of NAR Headquarters.

MODEL ROCKETRY SAFETY CODE**1. Construction**

My model rockets will be made of lightweight materials such as paper, wood, rubber, and plastic without any metal or other hazardous material as structural parts.

2. Engines

I will use only pre-loaded, factory-made, NAR-certified rocket engines in the manner recommended by the manufacturer. I will not alter or dismantle model rocket engines or their ingredients in any way, nor will I attempt to reload these engines.

3. Recovery

I will always use a recovery system in my model rockets that will return them safely to the ground so that they may be flown again. I will use only flame-resistant recovery wadding in my rockets.

4. Weight Limits

My model rockets will weigh no more than 1500 grams (53 oz) at liftoff and the engines will contain a total of no more than 125 grams (4.4 oz) of propellant. My model rockets will weigh less than the engine manufacturer's recommended maximum liftoff weight for the engine used, or I will use engines recommended by the manufacturer for my rockets.

5. Stability

I will check the stability of my model rockets before their first flight, except when launching models of already proven stability.

6. Payloads

My model rockets will never carry live animals, or payloads intended to be flammable or explosive.

7. Launch Area

I will launch my model rockets outdoors in a cleared area, free of tall trees, power lines, and buildings. I will ensure that people in the launch area are aware of the pending rocket launch and are in a position to see the rocket's liftoff before I begin my audible five-second countdown.

8. Launcher

I will launch my model rockets from a launch rod or other device which provides rigid guidance until the rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so that the end of the rod is above eye level, or I will cover the end of the rod when approaching it. I will cap or disassemble my launch rod when not in use, and will never store it in an upright position. My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, and other easy-to-burn materials.

9. Ignition System

The system I use to launch my model rockets will be remotely controlled and electrically operated, and will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launching switch. All persons will remain at least 15 feet from the model rocket when I am igniting engines totaling 30 Newtons-seconds or less of total impulse and at least 30 feet from the model rocket when I am igniting engines totaling more than 30 Newtons-seconds total impulse. I will use only electrical igniters that will ignite my rocket engines within one second of actuation of the launching switch.

10. Launch Safety

I will not let anyone approach a model rocket on a launcher until I have made sure that the safety interlock has been removed or the battery has been disconnected from the ignition system. In the event of a misfire, I will wait one minute before allowing anyone to approach the launcher.

11. Flying Conditions

I will launch my model rocket only when the wind is less than 20 miles per hour and under conditions where the model will not fly into clouds, fly near aircraft in flight, or be hazardous to people or property.

12. Pre-Launch Test

When conducting research activities with unproven designs or methods, I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

13. Launch Angle

I will not launch model rockets so that their flight path will carry them against targets. My launching device will be pointed within 30 degrees of vertical. I will never use model rocket engines to propel any device horizontally.

14. Recovery Hazards

If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

1. DEFINITIONS

- 1.1 **"Model rocket"** means an aero-model that ascends into the air without the use of aerodynamic lifting forces against gravity; that is propelled by means of a model rocket engine; that includes a device for returning it safely to the ground in a condition to fly again; and that contains no parts, particularly metal parts, that are likely to create a hazard. Model rocket engines and recovery system protectors or wadding, if present, do not constitute portions of a model rocket.
- 1.2 **"Model rocket engine"** means a reaction engine produced by a commercial manufacturer using preloaded combustible solid propellant as fuel.
- 1.3 A Glossary containing the official definitions of key words (which appear in boldface in the text of the rules) is provided in Appendix A.

2. GENERAL

- 2.1 This United States Model Rocket Sporting Code shall govern the design, construction, and operation of all model rockets and model rocket engines used in conjunction with:
 - (a) All competition sanctioned by the National Association of Rocketry (NAR); and
 - (b) All attempts to establish or surpass United States Model Rocket Performance Records.
- 2.2 The Model Rocketry Safety Code of the NAR shall be the general safety criteria to be followed in the interpretation and administration of this United States Model Rocket Sporting Code.
- 2.3 This United States Model Rocket Sporting Code shall not be construed to amend or otherwise serve as a substitute for the Sporting Code of the Federation Aeronautique Internationale (FAI) for the purposes of establishing or surpassing world model rocket performance records. Modelers who wish to attempt such records may obtain a copy of the FAI Sporting Code from the NAR Contest Supplies Subcommittee.

3. MODEL ROCKET SPECIFICATIONS

- 3.1 A model rocket must comply with all specifications in this section prior to launch, operation, and flight.
- 3.2 **Gross launching mass**, including model rocket engine or engines, shall in no event exceed 1500 grams (53 oz).
- 3.3 No more than a total of 125 grams (4.4 oz) of solid propellant materials shall be contained in its model rocket engine(s) at the moment of launch.
- 3.4 There shall be no more than three operable stages. The staged configuration of the model is considered to be that of the model at the instant of first motion on the launcher.
- 3.5 A model rocket shall be so constructed as to be capable of more than a single flight; and shall be provided with a means for retarding its descent to the ground so that its structure may not be substantially damaged, and so that no hazard is created to persons and property. If a model is to descend in more than one unattached part, each part must conform to the above specification.
- 3.6 Construction of the airframe shall be of wood, paper, rubber, plastic, or other similar materials consistent with the Safety Code.
- 3.7 Design and construction shall include suitable means for providing stabilizing and restoring forces necessary to maintain a substantially true and predictable flight path. If required by safety officers or judges, the builder of the model must present data demonstrating that this requirement has been met.
- 3.8 A model rocket possessing a self-contained powered ignition system (e.g., for remote ignition of upper stages) must be provided with a safety switch or other device capable of preventing actuation of the system and resultant ignition until immediately prior to the launch.
- 3.9 A model rocket equipped with a dethermalizer or other auxiliary device designed to operate via ignition or combustion must be designed so that ignition of the device presents no imminent hazard to the person igniting the device. In addition, the rocket must be designed so that the device is extinguished as soon as possible after performing its function (e.g., by the inclusion of a snuffer tube).

4. MODEL ROCKET ENGINE STANDARDS

- 4.1 A solid propellant model rocket engine shall have all of the propelling ingredients preloaded into the casing in such a manner that they cannot easily be removed. Delay trains and ejection charges may be included as an integral part of the engine, or may be preloaded and packaged separately by the manufacturer only if:
 - (a) the auxiliary package is a single preassembled unit containing all the remaining combustible material; and
 - (b) the auxiliary package is so designed that an average person would have no difficulty handling and using it safely.
- 4.2 A model rocket engine casing shall be made of nonmetallic material and shall be so constructed that it will not fragment if ruptured.

- 4.3 A single solid propellant model rocket engine shall contain no more than 62.5 grams of propellant, and shall produce no more than 80.0 Newton-seconds of total impulse, with a thrust duration of not less than 0.050 seconds.
- 4.4 An engine used in a model rocket in NAR sanctioned competition, or for the purpose of establishing a United States Model Rocket Performance Record, shall be of a type currently holding Contest Certification from the NAR. No model rocket engine shall be flown at any sanctioned NAR activity unless that engine holds a current Safety Certification from the NAR.
- 4.5 A model rocket engine shall not be altered in any manner to change its dimensions and/or its performance characteristics. No material shall be affixed to the engine in a permanent fashion (e.g., via glues or epoxies).
- 4.6 An NAR-certified model rocket engine is assigned a type classification based on its mean sea-level total impulse at a temperature of 20 degrees Celsius (plus or minus 5 degrees) as determined in static tests conducted by the NAR Standards and Testing Committee. NAR-certified model rocket engine classifications are as follows:

ENGINE CLASS	TOTAL IMPULSE (Newton-seconds)
¼ A	0.00 - 0.625
½ A	0.626 - 1.25
A	1.26 - 2.50
B	2.51 - 5.00
C	5.01 - 10.00
D	10.01 - 20.00
E	20.01 - 40.00
F	40.01 - 80.00

(NOTE: All engine classes listed above continue to be recognized for certification purposes independent of current commercial availability considerations.)

- 4.7 The total impulse values measured and published by the NAR Standards and Testing Committee shall be the values used in all NAR sanctioned competition and for United States Model Rocket Performance Record attempts.
- 4.8 When multiple engines are used in a single model rocket (e.g., clustering and staging), the total impulses of the individual engines shall be summed to compute the total impulse of the configuration and to determine the impulse class of an event for which the model qualifies.
- 4.9 NAR Safety Certification shall be granted only to model rocket engines that may be legally shipped in interstate commerce; whose total impulse is repeatable to within 20% (90% confidence interval no larger than $\pm 20\%$ of the mean value); and whose delay and ejection systems function reliably.
- 4.10 NAR Contest Certification shall be granted only to model rocket engines that are currently and readily available commercially; and that also meet the requirements of Rule 4.9, except that total impulse shall be required to be repeatable to within 10%.
- 4.11 An NAR-certified solid propellant model rocket engine shall carry on its casing a code to indicate date of manufacture, plus the following code to designate its performance:
- A letter indicating the total impulse type as detailed in Rule 4.6;
 - A number indicating the average thrust to the newest Newton; and
 - A dash, followed by a number indicating the time in seconds (to the nearest second) of the duration of the delay charge.

5. LAUNCHING REQUIREMENTS

- 5.1 During all operations concerned with the launching and flight of model rockets, all authority for the safety of operations on the flying field shall be vested in a Range Safety Officer (RSO) who must be a Senior member of the NAR in good standing. Deputy Range Safety Officers who are Senior or Leader members of the NAR in good standing may have this authority delegated to them by the RSO, but this delegation of partial authority does not relieve the RSO of the overall responsibility and authority on the flying field. If the RSO leaves the flying field, he must relinquish his duties and responsibilities to a new RSO who must be a Senior member of the NAR.
- 5.2 The flying field shall have a ground area whose shortest dimension is no less than one-fourth (1/4) the anticipated maximum altitude of the rockets to be flown. The flying field should not contain or be adjacent to high voltage lines, major highways, multi-story buildings, or other obstacles. The launching location shall be no closer than 10 meters to the boundaries of the flight area.
- 5.3 All model rockets presented for operation on the flying field shall be permitted or denied flight by the Range Safety Officer or his duly authorized deputy on the basis of his considered judgement with respect to safety.
- 5.4 A launching device or mechanism must be used that shall restrict the horizontal motion of the model until sufficient flight velocity is attained for reasonably safe, predictable flight. A launch rod composed of approximately one meter of 1/8" diameter rod is suggested for light models and models using less than 20 Newton-seconds of impulse; for heavier or

higher-powered models, a launch rod composed of approximately one meter of 3/16" or 1/4" diameter rod is recommended. A launching angle of less than thirty degrees (30°) from the vertical must be used.

- 5.5 A launcher must not impart to the model any velocity or change of momentum except that caused by the model rocket engine(s) contained in the model.
- 5.6 Launching or ignition of a model rocket must be conducted by remote electrical means at least 5 meters distant from the model, and must be fully under the control of the person launching the model. All persons in the vicinity of any launching must be advised that a launching is imminent before a model rocket may be ignited or launched. A minimum five-second countdown must be given before ignition or launching of a model rocket.
- 5.7 Winds shall be less than 35 kilometers per hour and visibility shall be greater than 500 meters before any model rocket may be ignited or launched.

6. SANCTIONED COMPETITION

- 6.1 The **NAR Contest Board** will sanction competition which is conducted in accordance with the rules set forth in this United States Model Rocket Sporting Code. See Rule 6.8.
- 6.2 The Contest Year shall begin on July 1; end on June 30 of the following year; and include the National Meet immediately following.
- 6.3 Competition sanctioned by the NAR shall be classified as follows:
 - 6.3.1 Section Meet: This is a competition among the members and guests of a chartered section of the NAR. Competition points awarded at a Section Meet may not be credited to a chartered section other than the section sponsoring the meet; except in the case of a convention sanctioned for the purpose of holding Research and Development Competition under the provisions of Rule 46.3. Section Meets have a Contest Factor of 1.
 - 6.3.2 Open Meet: This is a competition in which either:
 - (a) Two or more chartered NAR sections compete against one another; or
 - (b) Participation is open to all NAR members in a geographical area determined by the sponsor.
 An Open Meet may be sponsored by either a chartered section of the NAR, or by an individual member of the NAR. No fewer than five contestants must be present. No more than 75% of the contestants may enter as members of the same chartered section of the NAR. Open Meets have a Contest Factor of 2.
 - 6.3.3 Regional Meet: This is a competition which is both open to and attended by NAR members from a wide geographic region. A Regional Meet must satisfy one or more of the following criteria:
 - (a) The contestants represent two or more states;
 - (b) One or more contestants are represented from a distance of at least 50 miles from the meet; or
 - (c) One or more contestants are represented from an area which is sufficiently large that the National Contest Board gives a Contest Director explicit approval to hold a Regional Meet.
 A Regional Meet may be sponsored by either a chartered section of the NAR, or by an individual member of the NAR. No fewer than ten contestants, including proxy-flown contestants, must be represented. No more than 40% of the contestants may enter as members of the same chartered section of the NAR. A maximum number of contestants that are to be allowed at a Regional Meet may be set by the Contest Director. If such a limit is imposed, it must be stated on the "Application for a Contest Sanction." Applicants shall not be denied the right to compete on any other basis, with the exception of previous misconduct as specified in Rule 11.4. Regional Meets have a Contest Factor of 3.
 - 6.3.4 National Meet: Only one National Meet shall be held each year. The National Meet will be held at such time and place, with such entry requirements, and with such special rules as shall be determined by the NAR Contest Board. The National Contest Board shall determine the Contest Factor of National Meets by a formula designed to equate the points available to a contestant at the National Meet with the points available to a contestant from other competitions totaling 12 Contest Factors.
 - 6.3.5 Record Trial: This type of meet is conducted for the purpose of providing an opportunity and facilities for attempts to establish or surpass official United States and FAI model rocket performance records with no NAR contest points being awarded. Events to be flown must be indicated on the application for sanction. Any number or combination of events may be flown. In a Record Trial, an NAR member duly entered in the meet may have as many opportunities as time and weather permit to make a record flight. Record Trials have no Contest Factor.
- 6.4 All contests other than the National Meet must be scheduled and completed on no more than two consecutive days, except as stated in Rule 6.5.
- 6.5 Competition may be suspended by the Contest Director with the concurrence of a majority of the participating competitors present and a new date acceptable to a majority agreed upon for the completion of the contest. The Contest Director shall advise the Regional Contest Board regarding the rescheduling of the contest, and the reasons therefore.
- 6.6 Each competition event has a Weighting Factor which shall also be used in determining the maximum number of competition events that can be sanctioned for a particular contest. Any number of competition events may be sanctioned for a contest, provided that the sum of the Weighting Factors of all the competition events sanctioned for the contest does not exceed the Total Weighting Factor allowed for its contest classification. The schedule of Total Weighting Factors permitted for each contest classification is as follows:

Section Meet	45
Open Meet	57
Regional Meet	66
National Meet	Limit set by NAR Contest Board
Record Trial	No limit

- 6.7 Each competition classification (Rule 6.3) has a Contest Factor which shall be used in determining the maximum number of sanctioned contests in which an NAR member, team, or chartered NAR section may enter and compete during the Contest Year. No member, team, or section may officially enter a sanctioned contest and be awarded competition points if the Weighting Factor of that contest, when summed with the Weighting Factors of all the contests previously entered in the current Contest Year by the member, team, or section, would exceed twelve. In addition, a chartered NAR section may not sponsor more than five section meets during a Contest Year.
- 6.8 Application for sanction of a model rocket competition shall be made to the NAR Regional Contest Board at least thirty days in advance of the date of the competition, on the standard form "Application for a Contest Sanction," which is available from the NAR Regional Contest Board. If necessary, a reproduction of the form may be used when none can be secured from the NAR. The thirty-day advance notice requirement may be waived at the discretion of the NAR Regional Contest Board. The Senior Member of the NAR who will serve as the Contest Director must sign the application. The correct sanction fee must be included with the form mailed to the NAR Regional Contest Board. Contest Directors must purchase an adequate supply of contest forms, flight cards, etc., from the NAR Contest Supplies Subcommittee in advance of any competition, since this material will not be sent with the sanction for competition.
- 6.9 The NAR Senior Member who serves as the Contest Director for a sanctioned competition must report the competition results to the NAR Contest Board on the standard forms, and must include all the competition entry blanks, flight cards, and other contest record materials used. The report must be postmarked within fourteen days following the completion of the competition, but this requirement may be waived at the discretion of the NAR Regional Contest Board. The NAR Contest Board may refuse to accept the results of a competition if all the contest record materials are not included, if the data is not legible or accurate, or if there has been an unreasonable delay in reporting results.
- 6.10 The NAR Contest Board may refuse to accept the results of a competition if it feels that there is evidence supporting a reasonable doubt as to whether or not the competition was conducted within the scope or intent of this United States Model Rocket Sporting Code.
- 6.11 In all cases, contest results must be in the hands of the NAR Contest Board at least fourteen days in advance of the opening day of the National Meet.
- 6.12 Individual scores, if used as criteria for selection of contestants for the National Meet, shall be based on those scores in the hands of the NAR Contest Board by June 30 of the Contest Year. This does not preclude other means of selection.

7. CONTEST OFFICIALS

- 7.1 A Contest Director who is a Senior member of the NAR in good standing shall apply for contest sanction; receive and be responsible for all contest material; ensure that the competition is properly arranged and functions within the intent and specifications of this United States Model Rocket Sporting Code; and report the results of the competition. The duties of the Contest Director and the Range Safety Officer may be combined. The Contest Director appoints the Range Safety Officer, Contest Jury, Judges, Trackers, and Timers.
- 7.2 A Range Safety Officer (RSO) shall preside over the conduct of the competition in accordance with Rules 3 and 5. In no case may a **safety ruling** of the RSO be overridden by the Contest Director, Contest Jury, or any other official. The RSO may be relieved of his duties only by the Contest Jury.
- 7.3 A Deputy Range Safety Officer may be appointed by the RSO to function as Safety Check Officer. The Safety Check Officer shall be qualified to rule in accordance with Rule 5.3. The duties of the Safety Check Officer and the RSO may be combined.
- 7.4 There shall be a Contest Jury of three persons for each contest. The Contest Jury is empowered to make all decisions concerning any interpretation of the Sporting Code and to decide any disputes and protests. At least one jury member must be a Senior member of the NAR. The other jury members may be either Senior, Leader, or Junior members of the NAR. The Contest Director may act as one of the jury members. No juror shall rule or vote on any decision that could alter the award of contest points to his entry. Where a decision involving the entries of two jurors is involved, the ruling of the third juror shall be the determining factor. In the case of disputes, the ruling of two of the jurors present and acting shall be the determining factor. Any decision of the Contest Jury except for a **safety ruling** as stated in Rule 11.1 may be protested as described in Rule 12. The Contest Jury may not override a **safety ruling** of the RSO. No Contest Juror may be relieved of his duties by the Contest Director.
- 7.5 Teams of Judges shall be appointed by the Contest Director for events requiring static judging (e.g.: Research and Development, Scale, Plastic Model, and so on). All Judges must be members of the NAR, unless the rules for a specific event state otherwise. At least one member of each team of Judges must be a Senior or Leader member of the NAR.
- 7.6 Any capable person may be appointed by the Contest Director as a Tracker or Timer.

8. CONTESTANTS

- 8.1 All persons entering model rockets and competing in NAR sanctioned competition shall be members of the NAR in good standing who are enrolled under the coverage of the NAR liability insurance or approved equivalent. They are required to sign an official entry blank. The countersignature of a parent or guardian is required on the entry blank for minors, except for persons serving in the Armed Forces of the United States and students enrolled at the time in a college, university, or other institution of higher learning. Upon entering a competition, **contestants** must present for verification their NAR Sporting License to the Contest Director or his deputy.

- 8.2 For purposes of competition points and awards, the words age division shall mean Competition Age Division. The Competition Age Divisions are as given in the following schedule:

Division A	14 years old and younger
Division B	1.5, 16, and 17 years old
Division C	18 years old and older

- 8.3 The age division in which an NAR member will compete during a Contest Year is determined by the member's age as of July 1, the start of the Contest Year.
- 8.4 New NAR members who have not yet received their Sporting License shall be recorded as pending for meets. The Contest Director may require a pending member to show proof of his application for membership.
- 8.5 For the purpose of participating in NAR-sanctioned competition, a contestant who is not a current or pending member of the NAR may compete as a One-Time Member upon payment of the appropriate fee to the Contest Director. Neither competition points nor United States Model Rocket Performance Records will be awarded to One-Time Members.
- 8.6 At Open, Regional, or National Meets, representatives of competing NAR sections must present to the Contest Director or his deputy their current charter certificate for his inspection at his request.
- 8.7 A contestant properly entered in sanctioned competition may have his models flown by proxy by another NAR member, except in the following events or awards:
- Drag Race
 - Quadrathon Award
 - Research and Development,
 - Space Systems
 - Spot Landing

Models which are to be remotely-controlled or remotely-guided may not be proxy-flown. The builder of the model to be proxy-flown must furnish evidence satisfactory to the Contest Director of his inability to be present. Contestants having official duties may have their models proxy-flown for them with the approval of the Contest Director. An entry shall not be proxy-flown by a member whose Competition Age Division is older than that of the contestant.

- 8.8 In the event that the Contest Director disallows a proxy entry, this decision may be protested to the Contest Jury under the provisions of Rule 12. If the Contest Jury rules against the contestant, the decision may be appealed to the National Contest Board. In this instance, the contestant shall be allowed to fly, pending the decision of the National Contest Board; but his flight records shall be kept separate and shall not be considered official until the National Contest Board rules in favor of the contestant, if it so rules.
- 8.9 Two or more NAR members may enter competition as a team. Teams must be registered with the NAR Contest Board each year. Team renewals are due July 1 of each Contest Year. Membership of a team cannot be changed during the Contest Year. Such a change must be registered as a different team. At Section, Open, and Regional Meets, and in Craftsmanship events at National Meets, teams shall fly in the age division of their oldest member. In other events at National Meets, teams shall compete for competition points in a separate Team Division. One or more members of the team shall prepare entries for flight, except if they are to be proxy-flown under the provisions of Rule 8.7. Entry blanks shall carry the number of the team, with all individual team members' names and license numbers listed. All points earned and records established are credited to the team. Points earned in team competition are not entered in the individual's record of contest points, and may be used only for the team. No NAR member may enter a meet as both an individual and as a team member, and no NAR member may enter a meet as a member of more than one team; however, neither of these restrictions shall apply at Record Trials.
- 8.10 Where a group of NAR members enter competition as a chartered NAR section, all members of the group shall be bona-fide members in good standing of that section. Entry blanks shall carry the name of the section to which the member's points are to be credited. An NAR member or team may not enter competition as a member of more than one section during the course of a single Contest Year unless such a change is applied for and approved by the NAR Contest Board; however, any NAR member or team may enter a competition as an Independent competitor regardless of actual section affiliation.

9. ENTRIES

- 9.1 No entry in sanctioned competition shall be powered by an engine or combination of engines with total impulse greater

- than 80.00 Newton-seconds.
- 9.2 No entry in sanctioned competition shall eject its engine or engines in flight in such a manner that the spent engine casing or casings fall freely apart from the model. Ejected engine casings must descend with an attached and fully deployed streamer or parachute. The streamer area must be no less than 10 square centimeters for each gram of jettisoned mass; the parachute area must be no less than 5 square centimeters per gram of jettisoned mass. See Rule 9.12.
 - 9.3 Each entry shall carry, legibly displayed upon its exterior surface as the model rocket appears in flight readiness, the contestant's NAR license number. In the case of a team entry, the entry shall carry the team number.
 - 9.4 Each entry shall pass a safety inspection given by the Safety Check Officer before each flight to ascertain that it meets the standards of this Sporting Code, and that it will be reasonably safe in its operations, in accordance with Rule 5.3. This inspection shall include any launching device and auxiliary equipment provided by the contestant to assist the launch.
 - 9.5 The pre-flight safety inspection shall include a visual check of the markings on the engine(s) for proper impulse and delay. At the request of the contestant, the engine inspection shall be postponed until after the flight. However, if it is postponed, the part of the model containing the engine must be returned and Rule 10.4 shall not apply.
 - 9.6 At least two official entries in an event must be passed by the Safety Check Officer and must make official flights before points can be awarded in the event. This applies also where an event is flown in age divisions; i.e., two entries for each age division.
 - 9.7 Substitution of models between official flights of an event is allowed, unless disallowed by the rules for a specific event. When the rules for a specific event disallow substitution between official flights, only recovery devices and minor lost or damaged parts necessary to make the model flightworthy may be changed for subsequent flights. In these circumstances, a replacement for a minor lost or damaged part shall be identical to the part that it replaces.
 - 9.8 Two or more competition events may not be flown simultaneously by the same model rocket on the same flight.
 - 9.9 If an event is flown in age divisions, only two adjacent divisions may have their flight records combined.
 - 9.10 The RSO or his deputy shall make every reasonable effort to ensure that each contestant has completely constructed the model rocket(s) he uses in competition. Model rockets not requiring **construction** shall be excluded from competition. Materials and design may be obtained from any source, including kits.
 - 9.11 Models which are to be remotely-controlled or remotely-guided must be controlled or guided by the builder or builders of the model.
 - 9.12 The Contest Director or any of his appointed officials have the authority to require that any model having made an official flight be returned and impounded for a reasonable length of time for inspection if there is serious question regarding the adherence of the model to the Sporting Code. When the model or part cannot be returned within a reasonable time to the officials, the officials may disqualify that flight.

10. OFFICIAL FLIGHTS

- 10.1 Time and weather permitting, each contestant shall be given an opportunity to make no more than two official flights in each competition event unless otherwise specified in the rules for a specific event. This limitation shall not apply at Record Trials. It is suggested that the Contest Director carefully consider constraints imposed by time and weather when deciding on the number of flights that is to be allowed each contestant in an event, since in many events a contestant who cannot make both flights will be at a severe disadvantage. In such cases, it is preferable to limit contestants to one flight in one or more events than to impose a hardship on contestants who could not make both flights due to lack of time or inclement weather. If such a limitation is necessary, it should be announced prior to any official flight by any contestant in the event being so limited. In circumstances where it is necessary to enact such a limitation after official flights have been made in an event (e.g., a sudden weather change) all contestants, regardless of how many official flights they have already made, shall be bound by the new limit. In these circumstances, the Contest Director shall select for consideration only those flights of a contestant that would be qualified under the new limitation, and shall then choose the best of the selected flights as the official flight(s) of that contestant in that event. For example, if the Parachute Duration event must unexpectedly be limited to one flight per contestant, and a contestant has already made two flights, the Contest Director must first select only the flight(s) which were returned (since in single-flight Parachute Duration, the flight must be returned); if both flights were returned, the Contest Director shall select the better of the two flights as the official flight of the contestant.
- 10.2 At the discretion of the Contest Director, any NAR member or Team may be allowed to attempt to set or surpass a United States Model Rocket Performance Record in any class of any event listed in Rule 17.2, without regard to whether or not the event is listed on the sanction application for the meet. This rule shall not apply to Record Trials (see Rule 6.3.5).
- 10.3 A flight is official if an engine or engines in the model ignite(s); except in the case of a **catastrophic failure** according to the provisions of Rule 11.5, in which case the flight is not considered to be official.
- 10.4 When the return of a model is required, and the contestant cannot return his model, but can point out (to a qualified official) the model, visible in an inaccessible place such as a tree, power line, lake, or rooftop where recovery would pose a personal hazard to the contestant, the Contest Jury has the option of scoring the model as having been returned. The Range Safety Officer, the Contest Director, members of the Contest Jury, or Timers or Trackers assigned to follow the

contestant's model are qualified officials for the purposes of this rule. The Contest Director shall state prior to the start of competition what distance limits shall arbitrarily be imposed for this rule. This rule may be superseded by the rules of a specific event.

- 10.5 It is the responsibility of the contestant to ensure that the officials have noted on the entry card that the model has been returned, where it is so required.

11. DISQUALIFICATIONS

- 11.1 The Contest Jury and/or the Range Safety Officer or his deputies may disqualify any entry at any time which in their opinion does not comply with the competition rules, or which in their opinion may not be reasonably safe in operation.
- 11.2 An entry may by reason of flight characteristics be disqualified for that flight, but it is not necessarily disqualified for the entire event.
- 11.3 For the purposes of events in which a total score is computed from the sum of the performances of two or more flights, a disqualification shall result in a score of zero for that flight. This rule may be superseded by the rules of a specific event.
- 11.4 The Contest Director may disqualify any contestant from an event or from the entire meet on the grounds of failure to practice or observe reasonable safety measures, published or otherwise; for poor sportsmanship; for failure to abide by the orders of the Range Safety Officer or his deputies; or for misconduct in general.
- 11.5 A model rocket experiencing a **catastrophic failure** shall not be given a disqualification. The flight may or may not be considered as an official flight, at the option of the contestant. The contestant shall inform the Contest Jury of his decision to accept or reject the flight as an official flight as soon as possible; but in any case, prior to any subsequent flight by the contestant in that event. If the catastrophic failure occurs on the first official flight, the contestant shall be permitted to substitute another model; in the case of craftsmanship events, an identical model must be substituted. If the catastrophic failure occurs on any subsequent flight, substitution of another model is permitted only if the rules for the event being flown allow such substitution.
- 11.6 Performance data on an entry that has been disqualified during or after its flight shall be recorded, even though the flight may not at that time be considered official, in case of later reversal of the disqualification ruling.
- 11.7 Any entry experiencing three consecutive **misfires** shall be considered as having made one disqualified official flight. This does not disqualify an entry from further flights if permitted under the rules of the event.
- 11.8 A broken shock cord shall not cause a disqualification of the entry's flight unless a part of the entry falls to the ground and lands in a manner that the Range Safety Officer considers hazardous. This rule may be superseded by the rules for a specific event.
- 11.9 All models which do not leave the launcher subsequent to engine ignition shall be considered as having made a disqualified official flight; except as provided for in Rule 11.5. If the power pod or engine of a Boost/Glider model disengages and proceeds into the air under power without the glider portion, the attempt shall be considered a disqualified official flight.

12. PROTESTS AND APPEALS

- 12.1 Protests will be considered only when presented in writing to the Contest Jury no later than one hour after the end of the competition, and when accompanied by \$5.00 in cash.
- 12.2 The protesting competitor must report in full the action or decision under protest, the names of the contestants and officials involved, and other substantiating details.
- 12.3 The Contest Jury shall give to the Contest Director a brief statement of the situation and their decision. This statement shall be included with the contest results. If the protest is upheld, the protest fee shall be returned to the contestant. If the protest is denied, the protest fee shall also be included with the contest results.
- 12.4 A contestant may appeal a decision of the Contest Jury to the NAR Contest Board Chairman. Such appeals, written legibly or typed, must be postmarked within three days following the receipt by the contestant of the decision from the Contest Director on the original protest. If the appeal is upheld by the Contest Board, the protest fee paid at the meet shall be returned to the contestant.
- 12.5 The decision of the Contest Board on a protest is final.

13. COMPETITION POINTS AND CHAMPIONSHIPS

- 13.1 Competition points shall be awarded to each contestant on the basis of the following schedule: 10 points per event for placing first; 6 points per event for placing second; 4 points per event for placing third; 2 points per event for placing fourth; 1 point per event for making at least one qualified, official flight.
- 13.2 In case of a tie in any of the four places, duplicate points shall be awarded. This rule may be superseded by the rules for a

specific event.

- 13.3 Each competition classification as listed in Rule 6.3 has a Contest Factor as reiterated below:

Section Meet	1
Open Meet	2
Regional Meet	3
National Meet	set by Contest Board

- 13.4 Each event is assigned a Weighting Factor which is based on the difficulty of the event. These Weighting Factors are listed under the rules for each event.
- 13.5 Scores are calculated in the following way: Competition Points are multiplied by the Weighting Factor for each event. The result is then multiplied by the Contest Factor to produce the contestant's total score for the event. For example: A contestant places first in Scale Competition at an Open Meet. First place gives him 10 points; Scale has a Weighting Factor of 15; and an Open Meet has a Contest Factor of 2. Multiply $10 \times 15 \times 2$ to obtain the number of competition points to be awarded to the contestant for the event: 300 points.
- 13.6 Points scored in competition shall be official only when the contest results are accepted by the NAR Contest Board.
- 13.7 An event flown in age divisions shall be scored and points shall be awarded as if separate events were flown.
- 13.8 Competition points shall be cumulative for each NAR member, team, or section who enters and flies in sanctioned competition during each Contest Year.
- 13.9 A National Championship Award for a Contest Year shall be given in each age division to that NAR member who has compiled the largest number of contest points in his age division during that Contest Year. A Reserve National Championship Award for a Contest Year shall be given in each age division to that NAR member who has compiled the second-largest number of contest points in his age division during that Contest Year. To be eligible for either of these awards, a member must enter and fly in the National Meet at the close of the Contest Year.
- 13.10 A National Championship Team Award for a Contest Year shall be given to that NAR team which has compiled the largest number of contest points during that Contest Year. A Reserve National Championship Team Award for a Contest Year shall be given to that NAR team which has compiled the second-largest number of contest points during that Contest Year. To be eligible for either of these awards, a team must enter and fly in the National Meet at the close of the Contest Year.
- 13.11 A National Championship Section Pennant for the Contest Year shall be given to that chartered NAR section which has compiled among its members the largest number of contest points during that Contest Year. A Reserve National Championship Section Award for the Contest Year shall be given to that chartered NAR section which has compiled among its members the second-largest number of contest points during that Contest Year. To be eligible for either of these awards, a chartered NAR section must have at least one section member who enters and flies on behalf of that Section in the National Meet at the close of the Contest Year.

14. ALTITUDE DATA

- 14.1 All entries in any event for which an achieved altitude figure is scored shall be tracked in flight by theodolites of a design approved by the NAR Contest Board. Any tracking theodolite that:
- uses a rifle-sight or equivalent optical sight with or without lenses, or uses a pair of open sights mounted at least twenty centimeters apart;
 - uses crosshairs in the optical or open sight;
 - is mounted on a sturdy tripod or other solid base in a manner that does not permit the tracking head to wobble or otherwise lose its zero-reference under normal use; and
 - has a provision for securely holding the sights firmly in any desired position, so that the operator may accurately record the tracking data associated with a flight shall be acceptable for NAR contest use. Theodolites that do not meet all of the above requirements must be approved by the Contest Board before they may be used in a sanctioned activity.
- 14.2 Two or more tracking theodolites shall be used on measured baselines at least 300 meters in length. Longer baselines are encouraged for high-powered or high-performance models.
- 14.3 Theodolites must be equipped with both azimuth and elevation axes at right angles to each other, must be leveled or adjusted to an otherwise proper plane before use; and shall have an accuracy of $\pm 1^\circ$ in both azimuth and elevation.
- 14.4 Models shall be tracked to apogee if practical. When apogee tracking is used, one person shall be designated to give a "mark" to the theodolite operators at precisely the instant the entry appears to reach apogee, and the theodolites shall be locked at the "mark." At the discretion of the Contest Director, models may be tracked to ejection instead of apogee. When ejection tracking is used, it is recommended that the models to be tracked contain colored tracking powder to create a visible cloud at ejection, and that the theodolite operators "lock" their theodolites at the appearance of the tracking powder cloud. It is further recommended that all entries which are to be tracked be painted in colors or patterns that will aid tracking. All entries in an event shall be tracked using the same tracking method (either apogee or ejection).

- 14.5 It is strongly recommended that a reliable voice communication system be used to link both trackers and the launch control area, for the purpose of calling "marks" and for the transmission of tracking data
- 14.6 Angular data obtained from theodolite tracking shall be reduced to an achieved altitude figure by means of the approved standard system of equations, or other methods approved by the NAR Contest Board. All data shall be recorded for all altitude events and flights, including those flights that may be disqualified; this permits the altitude data to be available in case the disqualification ruling is later reversed.
- 14.7 The difference between the average altitude computed from both stations, and the individual altitudes in meters computed from each station's reduced altitude data must be less than or equal to 10% of the average to be considered valid and acceptable for competition and record flights. Flights whose reduced altitudes do not satisfy this constraint shall be scored as "track not closed." All altitudes shall be rounded off to the nearest meter before applying the "10% Rule." Fractions of a meter less than 0.5 must be rounded to the next lower meter; fractions 0.5 or above must be rounded to the next higher meter. The computed average altitude shall be the official scored altitude. When two parallel systems are used, it is only necessary that one pair of trackers (one at each station) close within 10% of the average altitude computed.
- 14.8 When multiple-station systems are used, the official altitude shall be that altitude computed from those two stations whose reduced altitude data agrees most closely with the average altitude generated (i.e., the two stations with the smallest error).
- 14.9 Novel altitude determination methods must be approved by the NAR Contest Board before the results are accepted for competition.

15. TIMING DATA

- 15.1 In all events for which a time-of-flight figure is scored, two Timers shall be stationed in the launching area with stop watches and may not leave the launching area in order to keep the model in sight. Optical aids other than sunglasses or eyeglasses to correct to normal vision may not be used by the Timers.
- 15.2 A Timer shall not time his own entry.
- 15.3 Stopwatches used for timing shall have a resolution no coarser than 1 /s second; shall have (at the minimum) standard start, stop, and reset capabilities; and shall be capable of being restarted from a stopped state without being reset. A stopwatch with split-time (or "lap accumulate") capabilities (i.e., one which continues to record time internally after being "stopped;" and which can display at any time, on demand, the total elapsed time since the watch was started) may be used for competition, provided that if it is used to time any entry, it shall be available for use to time any other entry in competition with it.
- 15.4 All entries shall be timed from the instant of **first motion** on the launcher until the part to be scored for time of flight touches the ground or is caught in a tree, power line, or otherwise stopped. As specified in Rule 1.1, engines, recovery system protectors, and wadding are not to be timed as portions of an entry.
- 15.5 The official time of flight shall be computed by averaging the elapsed times of flight recorded by each Timer to the nearest whole number of seconds. The individual elapsed times recorded by the Timers shall not be rounded before summing. After averaging the times, fractions of a second less than 0.5 shall be rounded to the next lowest second; fractions of 0.5 or above shall be rounded to the next highest second.
- 15.6 If the model disappears behind an obstacle to vision in such a manner as to lead the Timers to believe that it touched the ground very shortly thereafter, stopwatches shall be stopped when the model disappears; however, they may be started again if the model reappears. If the model drifts out of sight in the sky, the Timers shall stop their watches individually when they lose sight of it.
- 15.7 All data shall be recorded for all timing events and flights, including those flights that may be disqualified. This permits the timing data to be available in case the disqualification ruling is later reversed.
- 15.8 When a malfunction of a stopwatch or Timer occurs such that one of the two elapsed time measurements is not available, the elapsed time recorded by the other Timer shall be used as the official time. When both stopwatches or Timers malfunction, the flight shall not be considered an official flight unless the flight is disqualified on other grounds.

16. STATIC JUDGING

- 16.1 In events which require static judging (e.g.: Research and Development, Scale, Plastic Model, and so on) all entries in an event that are in competition with one another must be judged by the same team of one or more Judges. Several teams of Judges may be used for events conducted in age divisions, provided all entries in each event in each division are judged by the same Judges.
- 16.2 No Judge entered in an event shall judge his own entry, nor any entry in competition with it.
- 16.3 In conjunction with events requiring static judging, it is recommended that the Contest Director officially set aside a period of time between judging and launching during which the models can be viewed by the competitors and guests. The intent of this practice is to stimulate interest in craftsmanship events in modelers who may not otherwise enter such events, and improve the craftsmanship of those modelers who regularly do.

17. UNITED STATES MODEL ROCKET PERFORMANCE RECORDS

17.1 All United States Model Rocket Performance Records must be attempted, established, or surpassed during competition sanctioned by the National Association of Rocketry in accordance with this United States Model Rocket Sporting Code.

17.2 United States Model Rocket Performance Records which may be held or attempted are as follows:

Altitude	Design Efficiency	Altitude Efficiency
Super Roc Altitude	Payload	Egg Lofting Altitude
Parachute Duration	Streamer Duration	Helicopter Duration
Super Roc Duration	Quadrathon	Egg Lofting Duration
Rocket/Glider Duration		Boost/Glider Duration

17.3 All United States Model Rocket Performance Records will be awarded in age divisions.

17.4 Attempts to surpass an established United States Model Rocket Performance Record must exceed the value of the established record performance by at least 1 %.

17.5 No radio-controlled model may hold a United States Model Rocket Performance Record.

17.6 Homologation and certification of United States Model Rocket Performance Records will be carried out by the National Association of Rocketry Records Subcommittee. Standard forms for application for homologation of United States Model Rocket Performance Records are available from the NAR Records Subcommittee.

17.7 The record aspirant or the local Contest Director must notify the NAR Records Subcommittee within three days of the date of the record attempt. Full homologation forms do not have to be submitted at that time.

17.8 It is the responsibility of the record aspirant to furnish the following information and data:

- (a) The record aspirant's full name, address, and NAR license number.
- (b) The date, sanction number, location, and Contest Director's name and address for the NAR sanctioned competition in which the record attempt was made.
- (c) A copy of the aspirant's official entry form for the NAR sanctioned competition at which the record was set.
- (d) A copy of the official NAR flight card used to record the data about the flight during which the record was set.
- (e) The value of the performance attained in the record attempt.
- (f) A certification of the accuracy of the measuring equipment and instrumentation used.
- (g) The manufacturer and the type of the engine or engines used in the record attempt.
- (h) For parachute and streamer duration record attempts, the size, materials, and design of the parachute or streamer used.
- (i) Three copies of an accurate drawing to scale of the model used in the record attempt. This drawing is to include all principle dimensions, **gross launching mass**, and mass minus engine.
- (j) Three copies of a clear, glossy, and sharply-focused 5" x 7" enlargement of a photograph of the model used in the record attempt. A ruler must appear in the photograph to indicate the size of the model.
- (k) Certifying signatures of the record aspirant, the Contest Director, and at least two of the witnessing Judges. The standard application form for record homologation will contain space, where applicable, for this information and data.

17.9 It is the purpose of these homologation procedures and requirements to ascertain that a given model did indeed attain the flight performance claimed, and that a flight was made completely within the requirements of this United States Model Rocket Sporting Code. The NAR Records Subcommittee has the right to request any additional record substantiating data it feels may be necessary in the circumstances to achieve this purpose, and has the right to disallow any record claim, regardless of the homologation data submitted, if in the opinion of the NAR Records Subcommittee the record attempt was unfairly made or untruthfully reported.

18. PROVISIONAL COMPETITION

18.1 In order to foster the development of new events for national competition, the NAR Contest Board may publish twice a year provisional rules for those events which appear to have merit for inclusion into regular competition.

18.2 New events may be proposed by any NAR member or section for the consideration of the NAR Contest Board.

18.3 Rules for provisional competition shall be presented as for any established event. An appropriate Weighting Factor shall be chosen by the NAR Contest Board, to be used during the period of Provisional Competition.

18.4 An event shall retain its provisional status for at least two full contest years. It may then be adopted for inclusion into the next Sporting Code Revision by a vote of the NAR Contest Board. The Weighting Factor may be changed at this time for the purpose of regular competition.

18.5 During the provisional stage of an event, NAR members and sections are encouraged to suggest rule changes in the event for the purposes of improving the event, eliminating loopholes, or making the event more interesting. Contest Directors are encouraged to include Provisional events in meets, so that the rules can be tested for suitability before they are officially adopted.

- 18.6 A Provisional event may not be included in a National Meet until it has qualified under Rule 18.4; except by a special resolution of the NAR Board of Trustees.
- 18.7 Provisional events that engender little national interest or appear to offer no challenge after being tested in competition may be dropped after one year.
- 18.8 Provisional events submitted for the consideration of the NAR Contest Board must meet safety standards. In addition, they should be designed so that they can be flown in all sanctioned NAR meets, and from launching sites of limited size as well as large size. If applicable, a history of the event, including the number of times flown and the apparent degree of difficulty, should be included in the proposal.

ALTITUDE EVENTS

19. ALTITUDE COMPETITION

- 19.1 Altitude Competition comprises eight events open to any model rocket.
- 19.2 The purpose of this competition is to achieve the highest altitude.
- 19.3 Each entry shall be tracked in accordance with Rule 14.
- 19.4 Altitude Competition shall be scored as follows: the contestant whose entry achieves the highest altitude as tracked and reduced shall be declared the winner.
- 19.5 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Altitude Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼A	60	3
½ A	60	3
A	60	3
B	60	3
C	120	3
D	180	4
E	240	5
F	453	8

- 19.6 The model is not required to be returned to the officials, except as stated in Rule 9.12.

20. PREDICTED ALTITUDE COMPETITION

- 20.1 Predicted Altitude Competition comprises a single event open to any model rocket.
- 20.2 The purpose of this competition is to accurately predict the altitude that a model will attain.
- 20.3 Each entry shall be tracked in accordance with Rule 14.
- 20.4 The contestant must predict the altitude in meters to which the model will be flown. This predicted altitude shall be recorded on the flight card and given to the Contest Director or his deputy prior to any official flight by the contestant at the meet.
- 20.5 A contestant entered in Predicted Altitude Competition shall make all official flights in Predicted Altitude before flying any other event requiring tracking.
- 20.6 Entries shall be allowed only one official flight in Predicted Altitude Competition; except that a second flight shall be permitted if the first flight receives a "track not closed" or a "track lost," and the flight is not disqualified on any other grounds. If a second flight is granted, no substitution of models shall be allowed.
- 20.7 The minimum altitude prediction allowable is 100 meters.
- 20.8 Predicted Altitude Competition shall be scored as follows: the achieved altitude of the model shall be divided by the predicted altitude, and the result multiplied by 100. This figure shall then be rounded to the nearest 0.1 %. If the result is greater than or equal to 100, subtract 100 from it; otherwise, subtract it from 100. The contestant whose score comes closest to zero shall be declared the winner.
- 20.9 The Weighting Factor for Predicted Altitude Competition is 5.
- 20.10 The model is not required to be returned to the officials, except as stated in Rule 9.12.

21. DESIGN EFFICIENCY COMPETITION

- 21.1 Design Efficiency Competition comprises a single event open to any model rocket.
- 21.2 The purpose of this competition is to achieve the greatest possible efficiency from a model, where efficiency is measured in terms of achieved altitude per unit total impulse of the engine.
- 21.3 Each entry shall be tracked in accordance with Rule 14.

21.4 Design Efficiency Competition shall be scored as follows: the altitude in meters of each entry as tracked and reduced shall be divided by the total impulse in Newton-seconds of the engine or engines used to propel the model. The values used in the computation of total impulse shall be those values contained in the official engine list most recently published by the NAR Standards and Testing Committee. The resultant figure shall be rounded to the nearest integer, as described in Rule 14.7. The entry with the highest score thus achieved shall be declared the winner.

21.5 The Weighting Factor for the Design Efficiency Competition is 4.

21.6 The model is not required to be returned to the officials, except as stated in Rule 9.12.

22. ALTITUDE EFFICIENCY COMPETITION

22.1 Altitude Efficiency Competition comprises five events open to single-staged model rockets of fixed mass.

22.2 The purpose of this competition is to achieve the greatest possible efficiency from a model of given mass, powered by an engine of given impulse; where efficiency is measured in terms of achieved altitude.

22.3 Each entry shall be tracked in accordance with Rule 14.

22.4 Altitude Efficiency Competition shall be scored as follows: the contestant whose entry achieves the highest altitude as tracked and reduced shall be declared the winner.

22.5 This competition is divided into classes based on the maximum permissible total impulse of the engine(s) and the fixed gross launching mass. The following classes of Altitude Efficiency Competition are established:

Engine Class	Gross Launching Mass		Weighting Factor
	No less than	No more than	
¼ A	15 grams	20 grams	4
½ A	20 grams	25 grams	4
A	25 grams	30 grams	4
B	45 grams	50 grams	5
C	100 grams	110 grams	5

22.6 The model is not required to be returned to the officials, except as stated in Rule 9.12.

23. SUPER-ROC ALTITUDE COMPETITION

23.1 Super-Roc Altitude Competition comprises six events open to single-staged model rockets whose body length is no less than the minimum allowed for the classes of the event.

23.2 The purpose of this competition is to achieve the greatest altitude possible with the longest rocket possible without impairing the structural integrity of the rocket.

23.3 Each entry shall be tracked in accordance with Rule 14.

23.4 An entry that comes apart, bends so as to crimp the body, or has a similar structural failure during flight shall be disqualified.

23.5 The model is allowed to separate into two or more unattached parts after ejection, provided that each part conforms to the provisions of Rule 3.5. The recovery system shall be enclosed totally within the model until ejection.

23.6 Entries with bodies or significant structural parts made from hard or potentially unsafe material (e.g., fiberglass or doweling) shall not be allowed, under the provisions of Rule 1.1.

23.7 The entry will be disqualified if it fails to achieve the required minimum altitude, or if the flight results in a "track lost" or "no close."

23.8 Super-Roc Altitude Competition shall be scored as follows: the length in centimeters of the model, as measured from the tip of the nose cone to the end of the engine nozzle, shall be multiplied by a factor of 3 and awarded as static points. The altitude of the model in meters, as tracked and reduced, shall be multiplied by a factor of 2 and awarded as flight points. The static points and flight points thus obtained shall be added to determine the score. The contestant achieving the highest score shall be declared the winner.

23.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Super-Roc Altitude competition are established:

Engine Class	Minimum Length (centimeters)	Minimum Altitude (meters)	Gross Launching Mass (grams, max)	Weighting Factor
A	75	20	85	7
B	100	40	100	7
C	125	60	140	7
D	150	80	225	8
E	175	100	375	9
F	200	120	453	11

23.10 The model is not required to be returned to the judges except as stated in Rule 9.12.

24. PAYLOAD COMPETITION

- 24.1 Payload Competition comprises six events open to model rockets that carry one or more standard NAR model rocket payloads.
- 24.2 The purpose of this competition is to carry a payload of given mass and dimensions to as high an altitude as possible and to recover the payload. The standard NAR payload is intended to represent an instrument package whose dimensions and mass cannot be modified, but must be accepted as a design constraint.
- 24.3 The standard NAR model rocket payload is a nonmetallic cylinder containing no less than 21.0 grams of fine sand, with a total mass of no less than 28.0 grams. This cylinder shall be 19.0 millimeters (plus or minus 1.0 millimeter) in diameter. No holes may be drilled into it; no changes made in its shape; and no other material may be affixed to it.
- 24.4 The standard NAR model rocket payload or payloads carried in a model shall be completely enclosed and contained within the model, shall be removable from the model, and shall not separate from the model in flight.
- 24.5 Models in the competition must contain for recovery purposes one or more parachutes of sufficient size to allow a safe landing under the provisions of Rule 3.5.
- 24.6 If the model is staged, the payload must be enclosed in the uppermost stage of the model.
- 24.7 The payload shall not become separated from the entry during flight or upon landing, and the flight shall be disqualified if this occurs.
- 24.8 Each entry shall be tracked in accordance with Rule 14.
- 24.9 Following the flight, the contestant shall present his entry as recovered and, in the presence of an official, shall remove the payload. The official may require that the payload be weighed again at this time if there is a question as to whether or not mass may have been lost from the payload between the time of launch and the return of the entry.
- 24.10 If the official cannot examine the payload, the entry shall be disqualified.
- 24.11 If the contestant removes the payload in the absence of officials, the entry shall be disqualified.
- 24.12 If the payload is weighed after the flight and found to have a mass of less than 28.0 grams, the entry shall be disqualified.
- 24.13 No human intervention (e.g., catching the model) shall be allowed between launch and touchdown. If the model is not allowed to land naturally, the entry shall be disqualified.
- 24.14 Payload Competition shall be scored as follows: the entry achieving the highest altitude as tracked and reduced shall be declared the winner.
- 24.15 This competition is divided into classes based upon the maximum permissible total impulse of the engine(s). The following classes of Payload Competition are established:
- | Engine Class | Gross Launching Mass (grams, maximum) | Payloads Carried | Weighting Factor |
|--------------|---------------------------------------|------------------|------------------|
| A | 100 | 1 | 5 |
| B | 100 | 1 | 5 |
| C | 100 | 1 | 5 |
| D | 225 | 1 | 6 |
| E | 453 | 2 | 6 |
| F | 453 | 3 | 7 |
- 24.16 If the portion of the model containing the payload cannot be returned to the officials, the entry shall be disqualified. Rule 10.4 does not apply.

25. EGG LOFTING ALTITUDE COMPETITION

- 25.1 Egg Lofting Altitude Competition comprises five events open to model rockets that carry, as a totally-enclosed payload, one fresh USDA Large hen's egg, with a mass of no less than 55 grams and no more than 65 grams; and measuring no more than 45 millimeters in diameter.
- 25.2 The purpose of this competition is to carry an exceedingly fragile payload to as high an altitude as possible and to recover the payload without damage. The fresh egg is intended to simulate (in miniature) an astronaut, who must be properly cushioned and restrained to withstand the forces of acceleration and the shock of landing.
- 25.3 The Safety Check Officer or other official shall provide the egg to each contestant presenting his entry for pre-launch safety check. Each egg shall be numbered, and that number shall be recorded on the contestant's flight card.
- 25.4 On the first flight, a contestant shall not be required to use an egg that has been flown previously. It is strongly recommended that officials provide enough fresh eggs to ensure that all contestants may fly two official flights with eggs that have not been flown previously; however, if circumstances dictate, the contestant may be required to loft the same egg on both flights. A contestant shall not be required to use an egg that has been previously lofted by another contestant.

- 25.5 If the model is staged, the egg must be enclosed in the uppermost stage of the model.
- 25.6 Each entry shall be tracked in accordance with Rule 14.
- 25.7 Following the flight, the contestant shall present his entry as recovered and, in the presence of an official, shall remove the egg. The official shall determine the extent of damage to the egg.
- 25.8 If the official cannot examine the egg, the entry shall be disqualified.
- 25.9 If the contestant removes the egg in the absence of officials, the entry shall be disqualified.
- 25.10 If the shell of the egg is broken or cracked, the entry shall be disqualified.
- 25.11 No human intervention (e.g., catching the payload section or cushioning its landing) shall be allowed with respect to that portion of the model containing the egg between launch and touchdown. If the portion of the model containing the egg is not allowed to land naturally, the entry shall be disqualified.
- 25.12 Egg Lofting Altitude Competition shall be scored as follows: the entry achieving the highest altitude as tracked and reduced, and successfully recovering the egg without breaking or cracking, shall be declared the winner.
- 25.13 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Egg Lofting Altitude Competition are established:
- | Engine Class | Gross Launching Mass (grams, maximum) | Weighting Factor |
|--------------|---------------------------------------|------------------|
| B | 140 | 8 |
| C | 175 | 7 |
| D | 275 | 7 |
| E | 375 | 8 |
| F | 453 | 9 |
- 25.14 If the portion of the model containing the egg cannot be returned to the officials, the entry shall be disqualified. Rule 10.4 does not apply.

DURATION EVENTS

26. EGG LOFTING DURATION COMPETITION

- 26.1 Egg Lofting Duration Competition comprises five events open to single-staged model rockets that carry, as a totally enclosed payload, one fresh USDA Large hen's egg, with a mass of no less than 55 grams and no more than 65 grams; and measuring no more than 45 millimeters in diameter.
- 26.2 The purpose of this competition is to carry an exceedingly fragile payload for as long a time as possible and to recover the payload without damage. The fresh egg is intended to simulate (in miniature) an astronaut, who must be properly cushioned and restrained to withstand the forces of acceleration and the shock of landing.
- 26.3 Each entry contain for recovery purposes one or more parachutes of sufficient size to allow a safe landing under the provisions of Rule 3.5.
- 26.4 The Safety Check Officer or other official shall provide the egg to each contestant presenting his entry for pre-launch safety check. Each egg shall be numbered, and the number shall be recorded on the contestant's flight card.
- 26.5 On the first flight, a contestant shall not be required to use an egg that has been flown previously. It is strongly recommended that officials provide enough fresh eggs to ensure that all contestants may fly two official flights with eggs that have not been flown previously; however, if circumstances dictate, the contestant may be required to loft the same egg on both flights. A contestant shall not be required to use an egg that has been previously lofted by another contestant.
- 26.6 The entry may not separate into two or more unattached pieces, and shall be disqualified if it does so.
- 26.7 Each entry shall be timed in accordance with Rule 15.
- 26.8 Following the flight, the contestant shall present his entry as recovered and, in the presence of an official, shall remove the egg. The official shall determine the extent of damage to the egg.
- 26.9 If the official cannot examine the egg, the entry will be disqualified.
- 26.10 If the contestant removes the egg in the absence of officials, the entry shall be disqualified.
- 26.11 If the shell of the egg is broken or cracked, the entry shall be disqualified.
- 26.12 No human intervention (e.g., catching the model or cushioning its landing) shall be allowed between launch and touchdown. If the model is not allowed to land naturally, the entry shall be disqualified.
- 26.13 Egg Lofting Duration Competition shall be scored as follows: the contestant whose model achieves the longest duration is the winner.
- 26.14 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following

classes of Egg Lofting Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
B	140	7
C	175	6
D	275	6
E	375	7
F	453	8

26.15 Any model that cannot be returned to the officials shall be disqualified. Rule 10.4 does not apply.

27. PARACHUTE DURATION COMPETITION

27.1 Parachute Duration Competition comprises five events open to single-staged entries of no more than 85 grams **gross launching mass**, and containing one or more parachutes for recovery purposes.

27.2 The purpose of this event is to achieve the longest flight duration times.

27.3 Each entry shall be timed in accordance with Rule 15.

27.4 An entry shall be disqualified if it separates into two or more unattached parts.

27.5 An entry shall be disqualified if no portion of any parachute catches air.

27.6 Parachute Duration Competition shall be scored as follows: the durations achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner.

27.7 This competition is divided into classes based on the permissible total impulse of the engine(s). The following classes of Parachute Duration Competition are established:

Engine Class	Weighting Factor
¼ A	5
½ A	5
A	5
B	6
C	7

27.8 The contestant must return his entry to the officials after at least one of his qualified official flights. If the contestant fails to satisfy this requirement, he shall be disqualified; except as provided for by Rule 10.4.

28. INTERNATIONAL PARACHUTE DURATION COMPETITION

28.1 International Parachute Duration Competition comprises five events open to single-staged entries that contain one or more parachutes as the only recovery device.

28.2 The purpose of this event is to achieve the longest flight duration times.

28.3 Each entry shall be timed in accordance with Rule 15.

28.4 Parachute Duration models flown in this competition are identical to those flown in standard Parachute Duration Competition (Rule 27), and must meet the requirements defined by Rules 27.4 through 27.5. Due to this similarity, any U.S. Model Rocket Performance Records that may be set by models entered in this competition will be entered as standard Parachute Duration records.

28.5 Each contestant is initially allowed three official flights in this event.

28.6 A contestant may enter no more than two models in this event for the purposes of making his official flights, including any necessary additional flights.

28.7 The official duration of each flight shall be calculated as follows: if the duration achieved exceeds the maximum time limit defined in Rule 28.9, the entry shall be awarded the maximum time limit; otherwise, the entry shall be awarded its achieved duration in seconds.

28.8 International Parachute Duration Competition shall be scored as follows: the official durations achieved by the contestant on the initial three official flights in the event shall be summed. If there is no tie for first place, then the contestant achieving the highest score is the winner. If there is a tie, contenders for first place shall be given the opportunity to make additional official flights (flyoffs) to determine the winner. The maximum time limit for a contestant's first additional flight shall be computed by adding a one minute increment (or, at the discretion of the Contest Director, a greater increment) to the maximum time limit defined in Rule 28.9. For each subsequent additional flight made by a contestant, one additional increment shall be added to the previous maximum time limit. Additional flights shall be held in this manner until a winner is determined. Second through fourth places shall be distributed first among the other contenders in the flyoffs, and then among any other contestants having made qualified flights, on the basis of computed score.

- 28.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of International Parachute Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Time Limit (seconds)	Weighting Factor
¼ A	60	60	8
½ A	60	120	8
A	85	240	8
B	85	360	9
C	85	480	9

- 28.10 The models need not be returned, except as required by Rules 9.12 and 28.6.

29. STREAMER DURATION COMPETITION

- 29.1 Streamer Duration Competition comprises eight events open to single-staged entries that contain a single streamer as the only recovery device.
- 29.2 The purpose of this event is to achieve the longest flight duration times.
- 29.3 Each entry shall be timed in accordance with Rule 15.
- 29.4 A streamer is defined for this event as a piece of cloth, plastic, or paper, whose shape is approximately rectangular. The streamer must have a length-to-width ratio of five to one (5:1) or greater and have a minimum area of 100 square centimeters. The streamer and model must be connected by only a single line or cord, attached at the narrow end of the streamer. The cord may not be connected to either the streamer or the model at more than one point (e.g., no yokes are permitted). The streamer may not be cut, slit, or otherwise altered in such a manner as to affect its nature as a simple connected plane.
- 29.5 Several pieces of material may be assembled into a single streamer to overcome length restrictions imposed by the length of commercially-available material. All pieces of the streamer shall consist of identical material (e.g., the same type of crepe, plastic, or so on). Lengths of streamer material assembled in this manner must be joined in a manner so as to keep the aerodynamic effects of the joint as small as possible. All such joints shall be parallel to the narrow axis of the streamer.
- 29.6 Except for streamer protectors or wadding, an entry may not separate into two or more unattached parts, and shall be disqualified if it does so.
- 29.7 If an entry does not descend with its streamer fully deployed, it shall be disqualified.
- 29.8 Streamer Duration Competition shall be scored as follows: the durations achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner.
- 29.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Streamer Duration Competition are established.

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼ A	85	5
½ A	85	5
A	85	5
B	85	6
C	120	6
D	180	7
E	240	7
F	350	8

- 29.10 The contestant must return his entry to the officials after at least one of his qualified official flights. If the contestant fails to satisfy this requirement, he shall be disqualified; except as provided for by Rule 10.4.

30. INTERNATIONAL STREAMER DURATION COMPETITION

- 30.1 International Streamer Duration Competition comprises eight events open to single-staged entries that contain a single as only recovery device.
- 30.2 The purpose of this event is to achieve the longest flight duration times.
- 30.3 Each entry shall be timed in accordance with Rule 15.
- 30.4 Streamer Duration models flown in this competition are identical to those flown in standard Streamer Duration Competition (Rule 29), and must meet the requirements defined by Rules 29.4 through 29.7. Due to this similarity, any U.S. Model Rocket Performance Records that may be set by models entered in this competition will be entered as standard Streamer Duration records.
- 30.5 Each contestant is initially allowed three official flights in this event.
- 30.6 A contestant may enter no more than two models in this event for the purposes of making his official flights, including any necessary additional flights.

- 30.7 The official duration of each flight shall be calculated as follows: if the duration achieved exceeds the maximum time limit defined in Rule 30.9, the entry shall be awarded the maximum time limit; otherwise, the entry shall be awarded its achieved duration in seconds.
- 30.8 International Streamer Duration Competition shall be scored as follows: the official durations achieved by the contestant on the initial three official flights in the event shall be summed. If there is no tie for first place, then the contestant achieving the highest score is the winner. If there is a tie, contenders for first place shall be given the opportunity to make additional official flights (flyoffs) to determine the winner. The maximum time limit for a contestant's first additional flight shall be computed by adding a one minute increment (or, at the discretion of the Contest Director, a greater increment) to the maximum time limit defined in Rule 30.9. For each subsequent additional flight made by a contestant, one additional increment shall be added to the previous maximum time limit. Additional flights shall be held in this manner until a winner is determined. Second through fourth places shall be distributed first among the other contenders in the flyoffs, and then among any other contestants having made qualified flights, on the basis of computed score.
- 30.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of International Streamer Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Time Limit (seconds)	Weighting Factor
¼ A	85	30	8
½ A	85	60	8
A	85	120	8
B	85	180	9
C	120	240	9
D	180	300	10
E	240	300	10
F	350	300	11

- 30.10 The models need not be returned, except as required by Rules 9.12 and 30.6.

31. HELICOPTER DURATION COMPETITION

- 31.1 Helicopter Duration Competition comprises eight events open to any single-staged model rocket which uses the principle of autorotation as the sole means of recovery.
- 31.2 The purpose of this competition is to achieve the longest flight duration using an autorotating recovery system.
- 31.3 Each entry shall be timed in accordance with Rule 15.
- 31.4 Each entry must be decelerated during descent by its autorotating recovery device. The resulting autorotation must be around the roll axis of the model, and must be the result of proper deployment and operation of the recovery system.
- 31.5 Recovery devices employing flexible surfaces must contain rigid support members. The recovery system shall not be constructed solely of flexible material and rigging (e.g., a parachute). Entries using a recovery system which is designed to act (or which actually acts) in a manner similar to a parachute, a rigid inverted bowl, or similar techniques are specifically excluded from this competition.
- 31.6 The entry may not separate into two or more unattached parts, and shall be disqualified if it does so.
- 31.7 Helicopter Duration Competition shall be scored as follows: the duration achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner.
- 31.8 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Helicopter Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼ A	60	10
½ A	60	10
A	85	9
B	85	9
C	120	10
D	180	11
E	240	11
F	453	12

- 31.9 The contestant must return his entry to the officials after at least one of his qualified official flights. If the contestant fails to satisfy this requirement, he shall be disqualified; except as provided for by Rule 10.4.

32. SUPER-ROC DURATION COMPETITION

- 32.1 Super-Roc Duration Competition comprises six events open to single-staged model rockets whose body length is no less than the minimum allowed for the classes of the event.

- 32.2 The purpose of this competition is to achieve the greatest duration possible with the longest rocket possible without impairing the structural integrity of the rocket.
- 32.3 Each entry shall be timed in accordance with Rule 15.
- 32.4 An entry that comes apart, bends so as to crimp the body, or has a similar structural failure during flight shall be disqualified.
- 32.5 The entry may not separate into two or more unattached parts, and shall be disqualified if it does so. The recovery system shall be enclosed totally within the model until ejection.
- 32.6 Entries with bodies or significant structural parts made from hard or potentially unsafe material (e.g., fiberglass or doweling) shall not be allowed, under the provisions of Rule 1.1.
- 32.7 The entry will be disqualified if it fails to achieve the required minimum duration.
- 32.8 Super-Roc Duration Competition shall be scored as follows: the length in centimeters of the model, as measured from the tip of the nose cone to the end of the engine nozzle, shall be multiplied by a factor of 2 and awarded as static points. The achieved duration of the model in seconds shall be awarded as flight points. The static points and flight points thus obtained shall be added to determine the total points for each flight. The total points achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner.
- 32.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Super-Roc Duration competition are established:
- | Engine Class | Minimum Length (centimeters) | Minimum Duration (seconds) | Gross Launching Mass (grams, max) | Weighting Factor |
|--------------|------------------------------|----------------------------|-----------------------------------|------------------|
| A | 75 | 10 | 85 | 9 |
| B | 100 | 20 | 100 | 9 |
| C | 125 | 30 | 140 | 9 |
| D | 150 | 40 | 225 | 10 |
| E | 175 | 50 | 375 | 11 |
| F | 200 | 60 | 453 | 13 |
- 32.10 The contestant must return his entry to the officials after at least one of his qualified official flights. If the contestant fails to satisfy this requirement, he shall be disqualified; except as provided for by Rule 10.4.

33. PREDICTED DURATION COMPETITION

- 33.1 Predicted Duration Competition comprises a single event open to any model rocket.
- 33.2 The purpose of this competition is to accurately predict the duration that a model will achieve.
- 33.3 Each entry shall be timed in accordance with Rule 15.
- 33.4 The contestant must predict the duration in seconds which the model will achieve. This predicted duration shall be recorded on the flight card and given to the Contest Director or his deputy prior to any official flight by the contestant at the meet.
- 33.5 A contestant entered in Predicted Duration Competition shall make his official flight in Predicted Duration before flying any other event requiring timing.
- 33.6 Entries shall be allowed only one official flight in Predicted Duration Competition.
- 33.7 The minimum duration prediction allowable is 30 seconds.
- 33.8 The entry may not be remotely controlled or remotely guided.
- 33.9 The entry shall not contain a dethermalizer or other device whose purpose is to cause the model to land after a predetermined amount of elapsed time.
- 33.10 No human intervention (e.g., catching the model) shall be allowed between launch and touchdown. If the model is not allowed to land naturally, the entry shall be disqualified.
- 33.11 Predicted Duration Competition shall be scored as follows: the achieved duration of the model shall be divided by the predicted duration, and the result multiplied by 100. This figure shall then be rounded to the nearest 0.1 %. If the result is greater than or equal to 100, subtract 100 from it; otherwise, subtract it from 100. The contestant whose score comes closest to .zero shall be declared the winner.
- 33.12 The Weighting Factor for Predicted Duration Competition is 5.
- 33.13 The model is not required to be returned to the officials, except as stated in Rule 9.12.

34. BOOST/GLIDER DURATION COMPETITION

- 34.1 Boost/Glider Duration Competition comprises eight events open to any model rocket, one portion of which returns to the ground in stable, gliding flight supported by aerodynamic lifting surfaces which sustain that portion against gravity. Entries must utilize a vertical or near-vertical ballistic takeoff and a stable aerodynamic glide recovery.

- 34.2 The purpose of this competition is to achieve the longest flight duration times.
- 34.3 The gliding portion of each model shall be timed in accordance with Rule 15.
- 34.4 An entry that is supported by aerodynamic lifting forces in such a manner that it ascends in a shallow climb while under rocket power shall be disqualified from this competition.
- 34.5 An entry that descends with parachute and/or streamer recovery device(s) attached to the gliding portion of the model shall be disqualified. However, other portions of an entry may deploy parachutes and/or streamers for recovery purposes.
- 34.6 During the powered phase of flight, spinning or looping of the entry is permitted only around the roll axis or a parallel axis. Entries which spin or loop around the pitch or yaw axes shall be disqualified.
- 34.7 Entries that are radio-controlled are permitted by the rules of this competition. However, it is the option of the Contest Director to schedule instances of this competition in which no radio-controlled entries shall be permitted. When such an event is to be scheduled, the Contest Director must state this intention on the standard form "Application for a Contest Sanction."
- 34.8 Boost/Glider Competition shall be scored as follows: the durations achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner.
- 34.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Boost/Glider Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼ A	35	11
½ A	60	10
A	60	10
B	90	10
C	150	11
D	300	12
E	375	13
F	453	14

- 34.10 The contestant must return the gliding portion of his entry to the officials after at least one of his qualified official flights. If the contestant fails to satisfy this requirement, he shall be disqualified; except as provided for by Rule 10.4. However, any portion of an entry must be available for the officials' inspection if requested, as required by Rule 9.12.

35. INTERNATIONAL BOOST/GLIDER DURATION COMPETITION

- 35.1 International Boost/Glider Duration Competition comprises eight events open to any model rocket, one portion of which returns to the ground in stable, gliding flight supported by aerodynamic lifting surfaces which sustain that portion against gravity. Entries must utilize a vertical or near-vertical ballistic takeoff and a stable aerodynamic glide recovery.
- 35.2 The purpose of this competition is to achieve the longest flight duration times.
- 35.3 Boost/Gliders flown in this competition are identical to boost gliders flown in standard Boost/Glider Duration Competition (Rule 34), and must meet the requirements defined by Rules 34.4 through 34.7. Due to this similarity, any U.S. Model Rocket Performance Records that may be set by models entered in this competition will be entered as standard Boost/Glider Duration records.
- 35.4 Each contestant is initially allowed three official flights in this event.
- 35.5 A contestant may enter no more than two models in this event for the purposes of making his official flights, including any necessary additional flights.
- 35.6 The gliding portion of each entry shall be timed in accordance with Rule 15.
- 35.7 The official duration of each flight shall be calculated as follows: if the duration achieved exceeds the maximum time limit defined in Rule 35.9, the entry shall be awarded the maximum time limit; otherwise, the entry shall be awarded its achieved duration in seconds.
- 35.8 International Boost/Glider Competition shall be scored as follows: the official durations achieved by the contestant on the initial three official flights in the event shall be summed. If there is no tie for first place, then the contestant achieving the highest score is the winner. If there is a tie, contenders for first place shall be given the opportunity to make additional official flights (flyoffs) to determine the winner. The maximum time limit for a contestant's first additional flight shall be computed by adding a one minute increment (or, at the discretion of the Contest Director, a greater increment) to the maximum time limit defined in Rule 35.9. For each subsequent additional flight made by a contestant, one additional increment shall be added to the previous maximum time limit. Additional flights shall be held in this manner until a winner is determined. Second through fourth places shall be distributed first among the other contenders in the flyoffs, and then among any other contestants having made qualified flights, on the basis of computed score.
- 35.9 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of International Boost/Glider Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Time Limit (seconds)	Weighting Factor
¼ A	35	45	13
½ A	60	90	12
A	60	120	12
B	90	180	13
C	150	240	13
D	300	270	14
E	375	300	15
F	453	300	16

35.10 The models need not be returned, except as required by Rules 9.12 and 35.5.

36. ROCKET/GLIDER DURATION COMPETITION

- 36.1 Rocket/Glider Duration Competition comprises eight events open to any single-staged model rocket which returns to the ground in stable, gliding flight supported by aerodynamic lifting surfaces which sustain it against gravity. The model must utilize a vertical or near-vertical ballistic takeoff and a stable aerodynamic glide recovery.
- 36.2 The purpose of this competition is to achieve the longest flight duration times.
- 36.3 Each model shall be timed in accordance with Rule 15.
- 36.4 Any entry which, under any circumstances or in any manner, separates into two or more unattached pieces, or discards its engine casing(s), shall be disqualified.
- 36.5 Any entry that is supported by aerodynamic lifting forces in such a manner that it ascends in a shallow climb while under rocket power shall be disqualified from this competition.
- 36.6 Any entry that descends with parachute and/or streamer recovery device(s) attached shall be disqualified.
- 36.7 During the powered phase of flight, spinning or looping of the entry is permitted only around the roll axis or a parallel axis. Entries which spin or loop around the pitch or yaw axis shall be disqualified.
- 36.8 Entries that are radio-controlled are permitted by the rules of this competition. However, it is the option of the Contest Director to schedule instances of this competition in which no radio-controlled entries shall be permitted. When such an event is to be scheduled, the Contest Director must state this intention on the standard form "Application for a Contest Sanction."
- 36.9 Rocket/Glider Competition shall be scored as follows: the durations achieved by the contestant on all official flights in the event shall be summed. The contestant achieving the highest score is the winner..
- 36.10 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Rocket/Glider Duration Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼ A	35	13
½ A	60	12
A	60	12
B	90	13
C	150	13
D	300	14
E	375	15
F	453	16

- 36.11 The contestant must return his entry to the officials after at least one of his qualified official flights. If the contestant fails to this requirement, he shall be disqualified; except as provided for by Rule 10.4.

CRAFTSMANSHIP EVENTS

37. SCALE COMPETITION

- 37.1 Scale Competition comprises a single event open to any model rocket that is a true scale model of an existing or historical guided missile, rocket vehicle, or space vehicle.
- 37.2 The purpose of this competition is to produce an accurate, flying replica of a real rocket vehicle, that exhibits maximum craftsmanship in construction, finish, and flight performance.
- 37.3 Scale models of amateur rockets or missiles are specifically excluded from this competition, except when the prototype is of obvious historical significance.
- 37.4 Entries in Scale Competition may not model nonflying or inert prototypes. However, this does not preclude the collection

of data from a nonflying or inert round of a mass-produced prototype, provided that the contestant can substantiate that the data collected in this manner applies equally as well to the flying prototype that is being modeled.

- 37.5 Entries that qualify for Plastic Model Conversion Competition under Rule 42 are specifically excluded from this event. Parts from commercial plastic kits may be used on scale models provided this is pointed out in the data presented with the model for judging.
- 37.6 Any entry that has previously been entered at any sanctioned competition in the Sport Scale event under Rule 40 is specifically excluded from this event. Similarly, an entry may not be entered in both the Scale and Sport Scale events at any sanctioned competition.
- 37.7 Commercially-available flying scale model rocket kits are acceptable for entry only if accompanied by additional substantiating data other than that contained in the kit. The contestant shall be responsible for ascertaining the correct scale qualities of the kit, and must present satisfactory evidence that the kit model is to correct scale.
- 37.8 The contestant should model one particular serial-numbered prototype (or "round"); except in the case where the prototype is in such extensive mass-production that no single individual vehicle can be singled out for scaling. However, the contestant shall make every reasonable attempt to model a specific prototype, since any generalization may detract from his score.
- 37.9 The contestant must supply data to substantiate his model's adherence to scale in dimension, shape, color, and paint pattern.
- 37.10 If the prototype is a multi-staged vehicle, the scale model may be designed so that some or all of the upper stages are inoperable dummies. However, a scale model of only the upper stages of a multi-staged vehicle may not be entered -without the operable lower stage(s) unless specific data is furnished to prove to the judges that the upper stage configuration has flown separately, alone, and as a vehicle itself.
- 37.11 If the prototype is not stabilized by means of fins, or if the scaled fins are not of sufficient size to ensure the stable flight of the model, the scale model may be fitted with transparent plastic fins to make it stable in flight. However, the transparent fins and their attachment shall be judged for craftsmanship along with the model.
- 37.12 The NAR number required to be on the model by Rule 9.3 shall be judged for craftsmanship along with the model.
- 37.13 Models shall be judged for scale points in flight condition, with the exception that engine(s) and recovery system need not be present. Any clear plastic fins, launching lugs and fittings, and other exterior flight items must be attached to the model during scale judging. If they are not, the entry shall be disqualified. Nothing may be added to the model, or taken off the exterior of the model, between scale judging and flight; except the engine(s) and recovery system(s). If unusual recovery devices are to be used, it should be so noted in the data presented.
- 37.14 Each entry must make a safe, stable flight, and only one official flight shall be available for this purpose. If the entry does not make a safe, stable flight, it shall be disqualified.
- 37.15 No human intervention (e.g., catching the model or cushioning its landing) shall be allowed between launch and touchdown. If the model is not allowed to fly and land naturally, it shall be disqualified. However, in circumstances where there is an extraordinarily high probability of damage to models allowed to land naturally (e.g., rocky terrain or adjacent bodies of water downwind) the Contest Director may suspend this rule and permit contestants to catch their models. In this case, models which are caught shall be judged as if they had sustained maximum damage on landing, but shall not be disqualified. This rule shall not be interpreted as disallowing remotely controlled or remotely guided scale models.
- 37.16 Each entry shall be judged using the standard form "Scale Model Judging Sheet" which is available from the NAR Contest Supplies Subcommittee.
- 37.17 Static points shall be awarded according to the following schedule:
 - 37.17.1 Scale Data: 50 points.

Points shall be awarded for data which exceeds the minimum requirements; however, data will be judged on quality, not quantity. All data presented should apply to the particular prototype that is being modeled. Minimum allowable data consists of:

 - (a) scale factor;
 - (b) overall length;
 - (c) diameter(s);
 - (d) nose cone length;
 - (e) fin length, width, and thickness (if applicable to the prototype);
 - (f) length of transition pieces (if applicable);
 - (g) color pattern (documented either in writing or by photographs);
 - (h) one clear photograph, halftone, or photo-reproduction; and
 - (i) for all required dimensions listed above, both the actual (prototype) dimensions and the scaled (model) dimensions presented in a table or on a drawing"

Dimensional data must be from an accurate source, such as magazines, books, the prototype manufacturer's specifications or data sheets, and so on. Drawings prepared by the modeler to facilitate judging must be accompanied by substantiating data or drawings. Photographs from any source are acceptable. The photograph requirement may

be satisfied by reproductions of pictures from books and other printed material only if the reproduction is equal in clarity to the original. Any entry not accompanied by the minimum allowable data as listed above shall be disqualified. In addition, the modeler should make an effort to include in the table (or drawing) any additional dimensions (both prototype and scaled) which he has tried to accurately scale. Points may be deducted if the scale packet contains data not pertinent to the prototype model, or is presented in such a manner as to complicate judging. The entry shall be judged by the data presented in the scale packet.

- 37.17.2 Accuracy of Major Dimensions: 200 points.
Major dimensions include dimensions required under Rule 37.17.1; as well as dimensions of subassemblies, location of details, location of paint pattern, and so on. It is recommended that calipers be used to check small scale dimensions and that Judges attempt to measure the main model dimensions to at least 0.5 millimeters. Points shall be deducted according to the percentage of deviation from the scale dimensions.
- 37.17.3 Accuracy of Color and Markings: 100 points.
The color and texture (e.g., flat, glossy) of the paint should conform to the data and photographs. Lettering and insignia, if applicable, should be scaled and properly reproduced. Paint patterns should be properly proportioned.
- 37.17.4 Accuracy of Details: 50 points.
Detail such as antennas, rivets, cover plates, bolts, prototype imperfections, and so on, that appear in the data should be present and properly scaled.
- 37.17.5 Craftsmanship: 300 points.
Points will be awarded for neatness, care in construction, craftsmanship of details, and quality of finish. Consideration should be given to the visibility of body seams and wood grain, the proper curving of curved lines, and edges made properly sharp or rounded as shown in the substantiating data. The finish should be free of fingerprints, brush strokes, runs, or other unintentional blemishes; and the paint pattern should be well-defined. The details should be precise; and neither more nor less obvious than on the prototype. The NAR number of the contestant should be neatly displayed.
- 37.17.6 Degree of Difficulty: 200 points.
Points shall be awarded according to the difficulty experienced by the modeler in building the model and adapting it for flight. Consideration should be given to whether the model was built from a kit. Points should be awarded for parts and details that were individually constructed by the modeler. (To facilitate judging, the contestant should point out difficult assemblies or construction problems in his scale packet.)
- 37.18 Flight points shall be awarded according to the following schedule:
- 37.18.1 Flight Characteristics: 100 points.
Flight Characteristics points are awarded for proper operation of the model during flight, including launch, stability, staging (if applicable), recovery, and lack of damage on landing. Consideration should be given for scale-like flight characteristics (e.g., spinning like the prototype).
- 37.19 Scale Competition shall be scored as follows: the points awarded to the entry in static judging shall be added to the points awarded to the entry in flight. The contestant receiving the highest score is the winner.
- 37.20 The Weighting Factor for Scale Competition is 15.
- 37.21 Any model that cannot be returned to the Judges shall be disqualified, except as provided for by Rule 10.4.

38. SCALE ALTITUDE COMPETITION

- 38.1 Scale Altitude Competition comprises eight events open to any model rocket that is a true scale model of an existing or historical guided missile, rocket vehicle, or space vehicle.
- 38.2 The purpose of this competition is to produce an accurate, flying replica of a real rocket vehicle, that exhibits maximum craftsmanship in construction, finish, and flight performance; and to achieve the greatest possible altitude with the model.
- 38.3 The model rocket and its flight must comply with the rules of the Scale Competition (Rule 37) and shall be judged for scale qualities and awarded scale points according to the rules for Scale Competition.
- 38.4 The Judges may disqualify any model which, in their opinion, does not show sufficient scale substantiation or evidence of the normal level of workmanship required for a scale model under the provisions of the Scale Competition. The intent of this rule is to eliminate from competition any entry for which scale qualities have been grossly subordinated in favor of altitude performance characteristics.
- 38.5 Scale Altitude Competition shall be scored as follows: the total number of scale points awarded to the entry shall be added to the altitude in meters achieved by the entry. If the flight results in a "track lost" or "no close," no altitude points are added. The contestant achieving the highest score shall be declared the winner.
- 38.6 This competition is divided into classes based on the maximum permissible total impulse of the engine(s). The following classes of Scale Altitude Competition are established:

Engine Class	Gross Launching Mass (grams, maximum)	Weighting Factor
¼ A	60	15
½ A	60	15
A	60	15
B	60	16
C	120	16
D	180	16
E	240	17
F	453	17

38.7 Any model that cannot be returned to the Judges shall be disqualified. Rule 10.4 does not apply.

39. SUPER SCALE COMPETITION

39.1 Super Scale Competition comprises a single event open to any entry consisting of:

- (a) A model rocket that is a true scale model of an existing or historical guided missile, rocket vehicle, or space vehicle; and
- (b) A launching complex that is a true scale model of the launching complex used by the prototype of the scale model rocket.

39.2 The purpose of this competition is to produce an accurate flying replica of a real rocket vehicle, and an accurate working replica of its actual launching complex; both of which exhibit maximum craftsmanship in construction, finish, and performance.

39.3 The model rocket and its flight must comply with the rules of the Scale Competition (Rule 37) and shall be judged for scale qualities and awarded scale points according to the rules for Scale Competition.

39.4 The launching complex and the model rocket shall be judged for scale qualities at the same time.

39.5 The launching complex shall be of the same prototype (or "round") as that used to launch the particular serial-numbered prototype rocket entered by the modeler.

39.6 A model rocket launching device satisfying the requirements of Rules 5.4, 5.5, and 5.6 shall be built as an integral part of the scale launching complex.

39.7 Scale points shall be awarded to the launching complex according to the following schedule:

39.7.1 Scale Data: 50 points.

Points will be awarded for data which exceeds the minimum requirements; however, data will be judged on quality, not quantity. All data presented should apply to the particular prototype that is being modeled. Minimum allowable data consists of:

- (a) scale factor;
- (b) color pattern (documented either in writing or by photographs);
- (c) one clear photograph, halftone, or photo-reproduction;
- (d) substantiation that the particular launcher modeled was indeed used to launch the prototype rocket chosen; and
- (e) for all dimensions that the modeler has attempted to accurately scale, both the actual (prototype) dimensions and the scaled (model) dimensions, presented in a table or on a drawing.

Any entry not accompanied by the minimum allowable data as listed above shall receive zero scale points for the launching complex. In addition, the data presented should show all the details of the launch complex in order to receive maximum points. Points may be deducted if the scale packet contains data not pertinent to the prototype launcher; if the data is presented in such a manner as to complicate judging; if the scale indicated on the data does not match the scale of the model launching complex; or if the launching complex is not to the same scale as the model rocket.

39.7.2 Accuracy of Major Dimensions: 200 points.

Major dimensions include dimensions of subassemblies, location of details, location of paint pattern, and so on. It is recommended that calipers be used to check small scale dimensions and the judges attempt to measure the main model dimensions to at least 0.5 millimeters. Points shall be deducted according to the percentage of deviation from the scale dimensions.

39.7.3 Accuracy of Color and Markings: 50 points.

The color and texture (e.g., flat, glossy) of the paint should conform to the data and photographs. Lettering and insignia, if applicable, should be scaled and properly reproduced. Paint patterns should be properly proportioned.

39.7.4 Accuracy of Details: 50 points.

Details such as rivets, cover plates, bolts, cables, prototype imperfections, and so on, that appear in the data should be present and properly scaled.

- 39.7.5 General Appearance: 100 points.
The launch complex should look like the photo(s) of the prototype launcher. No points shall be deducted for neatly-constructed modifications to the launching complex which are necessary to effect the safe and proper launching of a model rocket.
- 39.7.6 Craftsmanship: 250 points.
Points will be awarded for neatness, care in construction, craftsmanship of details, quality of finish, and construction of movable parts (if applicable). Consideration should be given to the visibility of wood grain and the proper curving of curved parts. The finish should be free of fingerprints, brush strokes, runs, or other unintentional blemishes; and the paint pattern should be well-defined. The details should be precise, and neither more nor less obvious than on the prototype. In addition, consideration should be given for the ingenuity and care with which the launching device is built into the launching complex.
- 39.7.7 Degree of Difficulty: 200 points.
Points shall be awarded according to the difficulty experienced by the modeler in building the launching complex and adapting it for the launching of the scale model rocket. Points to be considered by the Judges include the use of prefabricated parts and details; intricacy of the complex; number of detailed components; difficulty of detailing; difficulty of finishing; parts and details that were individually constructed by the modeler; and difficulty in adapting the complex to launch model rockets. (To facilitate judging, the contestant should point out difficult assemblies or construction problems in his scale packet.)
- 39.7.8 Operation: 100 points.
Points shall be awarded for success of operation under launch conditions; lack of damage under launch; and realism. In addition, points shall be awarded for working parts operated manually or by automatic or remote control under launch conditions.
- 39.8 Super Scale Competition shall be scored as follows: the points awarded the model rocket in static judging, the points awarded the model rocket in flight, and the points awarded to the launching complex shall be summed. The contestant receiving the highest score is the winner.
- 39.9 The Weighting Factor for Super Scale Competition is 20.
- 39.10 Any model that cannot be returned to the Judges shall be disqualified. Rule 10.4 does not apply.

40. SPORT SCALE COMPETITION

- 40.1 Sport Scale Competition comprises a single event open to any model rocket that resembles an existing or historical guided missile, rocket vehicle, or space vehicle.
- 40.2 The purpose of this competition is to produce a flying replica of a real rocket vehicle, that exhibits maximum craftsmanship in construction, finish, and flight performance. Sport Scale Competition differs from Scale Competition (Rule 37) in that the dimensions of the model are not directly measured, and that the model is not closely inspected by the Judges.
- 40.3 Sport Scale models of amateur rockets or missiles are specifically excluded from this competition, except when the prototype is of obvious historical significance.
- 40.4 Entries in Sport Scale Competition may not model nonflying or inert prototypes. However, this does not preclude the use of photographs or drawings of a nonflying or inert round of a mass-produced prototype, provided that the contestant can substantiate that the data collected in this manner applies equally as well to the flying prototype that is being modeled.
- 40.5 Entries that qualify for Plastic Model Conversion Competition under Rule 42 are specifically excluded from this event. Parts from commercial plastic kits may be used on Sport Scale models, provided this is pointed out in the data presented with the model for judging.
- 40.6 Any entry that has previously been entered at any sanctioned competition in the Scale event under Rule 37 is specifically excluded from this event. Similarly, an entry may not be entered in both the Scale and Sport Scale events at any sanctioned competition.
- 40.7 The contestant must supply data to substantiate his model's adherence to scale in shape, color, and paint pattern.
- 40.8 If the prototype is a multi-staged vehicle, the scale model may be designed so that some or all of the upper stages are inoperable dummies. However, a scale model of only the upper stages of a multi-staged vehicle may not be entered without the operable lower stage(s) unless specific data is furnished to prove to the judges that the upper stage configuration has flown separately, alone, and as a vehicle itself.
- 40.9 If the prototype is not stabilized by means of fins, or if the scaled fins are not of sufficient size to ensure the stable flight of the model, the scale model may be fitted with transparent plastic fins to make it stable in flight. However, the transparent fins and their attachment shall be judged for craftsmanship along with the model.
- 40.10 The NAR number required to be on the model by Rule 9.3 shall be judged for craftsmanship along with the model.
- 40.11 Models shall be judged for static points in one of the following manners:

- 40.11.1 Where space allows, the contest officials shall cordon off a circle of at least two meters in diameter. Each model shall be placed in turn in the center of the circle by the contestant, or by a contest official other than the Judges. The Judges may circle the model with the rope as a guide.
- 40.11.2 If models are to be judged in an area where this is not practical, such as a small room, the contest officials shall cordon off an end of the room at a distance of at least 1.5 meter. Each model shall be placed in turn at least one meter from the cordon by the contestant, or by a contest official other than the Judges. At the request of the Judges, the model shall be rotated so that all sides may be inspected.
- 40.12 The Judges shall not pick up any entry, nor examine it from a closer distance during the judging or flight.
- 40.13 Models shall be judged for scale points in flight condition, with the exception that engine(s) and recovery system need not be present. Any clear plastic fins, launching lugs and fittings, and other exterior flight items must be attached to the model during scale judging. If they are not, the entry shall be disqualified. Nothing may be added to the model, or taken off the exterior of the model, between scale judging and flight; except the engine(s) and recovery system(s).
- 40.14 Details that are not visible during judging (e.g., dummy engines, interior assemblies, very fine detail not visible from the required distance) shall not be considered in scoring the entry.
- 40.15 Each entry shall make a safe, stable flight, and only one official flight shall be available for this purpose. If the entry does not make a safe, stable flight, it shall be disqualified.
- 40.16 No human intervention (e.g., catching the model or cushioning its landing) shall be allowed between launch and touchdown. If the model is not allowed to fly and land naturally, it shall be disqualified. However, in circumstances where there is an extraordinarily high probability of damage to models allowed to land naturally (e.g., rocky terrain or adjacent bodies of water downwind) the Contest Director may suspend this rule and permit contestants to catch their models. In this case, models which are caught shall be judged as if they had sustained maximum damage on landing, but shall not be disqualified. This rule shall not be interpreted as disallowing remotely-controlled or remotely-guided scale models.
- 40.17 Static points shall be awarded according to the following schedule:
- 40.17.1 Similarity of Outline: 200 points.
The contestant is required to submit data to substantiate his model's visual resemblance to the prototype. Minimum allowable data consists of:
(a) A line, tone, or color drawing; or
(b) One or more clear photographs, halftones, or photo-reproductions of the prototype, sufficient to show the outline and general configuration of the prototype modeled.
- Any entry not accompanied by the minimum allowable data as listed above shall be disqualified. The Judges may disqualify any entry which, in their opinion, is accompanied by substantiation data of such poor quality as to fail to convey a satisfactory impression of the outline and general configuration of the prototype.
- 40.17.2 Finish, Color, and Markings: 200 points.
The contestant should submit data to substantiate his model's fidelity to the prototype. Suggested options include:
(a) One or more clear photographs, halftones, or photo-reproductions; including at least one in color. The number of these submitted should be sufficient to substantiate additional views of the model on which the color pattern and markings differ significantly.
(b) Other published pictorial representations, such as a color painting, or a drawing from a magazine.
(c) A detailed written description, from a reliable source, of the color scheme and markings; accompanied by a drawing of the prototype on which the color scheme and markings described have been included. This drawing may be neatly made by the modeler.
- Any entry not accompanied by data substantiating the finish, color, and markings of the prototype shall be given zero points for Finish, Color and Markings; but shall not be disqualified from the competition.
- 40.17.3 Degree of Difficulty: 100 points.
Points shall be awarded according to the difficulty experienced by the modeler in building the model and adapting it for flight. Minor consideration should be given to whether the model was built from a kit. Points should be awarded for parts and details that were individually constructed by the modeler. (To facilitate judging, the contestant should point out difficult assemblies or construction problems in his substantiation data packet.)
- 40.17.4 Craftsmanship: 300 points.
Points will be awarded for neatness, care in construction, craftsmanship of visible details, and quality of finish. Consideration should be given to the visibility of body seams and wood grain, the proper curving of curved lines, and edges made properly sharp or rounded as visible from the substantiating data. The finish should be free of fingerprints, brush strokes, runs, or other unintentional blemishes; and the paint pattern should be well-defined. The details should be precise, and neither more nor less obvious than on the prototype. The NAR number of the contestant should be neatly displayed.
- 40.18 Flight points shall be awarded according to the following schedule:
- 40.18.1 Mission: 20 points.
Mission points are awarded for appropriate and scale-like operation of the model during flight. Examples of such

operations are staging, simulated cloud seeding, operation of electronic payload, and smoke ejection. Any such operation must comply fully with the safety standards set forth in this NAR Sporting Code. If it does not, the entry shall be disqualified. The RSO is the only official who may judge the safety qualities of the operation.

- 40.18.2 General Flight: 180 points.
General Flight points are awarded for proper operation of the model during flight, including launch, stability, recovery, and lack of damage on landing. No consideration should be given to staging or scale-like flight characteristics, as these are covered under Mission points; however, if the general flight performance of the model is adversely affected by the failure of one or more of these aspects, points may be deducted from General Flight.
- 40.19 Sport Scale Competition shall be scored as follows: the points awarded to the entry in static judging shall be added to the points awarded to the entry in flight. The contestant receiving the highest score is the winner.
- 40.20 The Weighting Factor for Sport Scale Competition is 11.
- 40.21 Any model that cannot be returned to the Judges shall be disqualified, except as provided for by Rule 10.4.

41. SPACE SYSTEMS COMPETITION

- 41.1 Space Systems Competition comprises a single event open to any entry which is an apparent likeness of an existing or historical guided missile, rocket vehicle, or space vehicle; and carries a standard NAR payload.
- 41.2 The purpose of this competition is to duplicate in miniature the situation and problems encountered in the full-scale operation of a sounding rocket or space vehicle with instrumented range support. The contestant acts in the capacity of a Project Officer, and is faced with the same decisions and must make many of the same compromises as his professional counterpart. As in full-scale operation, he does not have control over all the factors that will influence the flight and success of his vehicle.
- 41.3 The model rocket and its flight must comply with the rules of the Sport Scale Competition (Rule 40) and shall be judged for scale qualities and awarded scale points according to the rules for Sport Scale Competition.
- 41.4 Each entry may be accompanied by its own launcher which shall resemble as closely as practical the launcher of the prototype. If such a launcher is entered, it shall be judged for scale qualities at the same time and in the same manner as the model. The Judges may award up to a total of 50 points for the contribution of such a launcher towards the general appearance of the entry.
- 41.5 Each entry must be accompanied at static judging time by its own electrical ignition system that has been assembled by the contestant. The ignition system must include its own electrical power supply. This equipment may not be shared with any other contestant at any time during this competition event.
- 41.6 All entries (including launchers if entered) shall be judged before flight for scale points.
- 41.7 During the static judging, ignition systems shall be checked for adequate safety provisions in accordance with Rule 5.6.
- 41.8 Each entry must carry a standard NAR payload, and comply fully with Rules 24.3 through 24.7.
- 41.9 During or after the judging for scale points, all contestants shall attend a Range Scheduling Meeting conducted by the Range Safety Officer or his deputy.
- 41.9.1 The RSO shall assign each contestant a launching time (T-time). This T-time is the starting time of a three-minute launch window. Assignment of T-times shall be determined by drawing lots. All watches shall be synchronized with that of the RSO.
- 41.9.2 The RSO shall designate a Safe Recovery Area which shall be marked on the range by four poles. The Safe Recovery Area shall be approximately rectangular, and each side of the area shall be at least 50 meters long.
- 41.9.3 The RSO shall assign launching areas to the contestants by drawing lots. However, if there are more contestants than available launching areas, the RSO shall schedule the use of the available launching areas according to the contestants T-times, allowing at least fifteen minutes for a contestant to set up his entry in a launching area prior to his T-time.
- 41.9.4 During the Range Scheduling Meeting, each contestant shall announce the altitude in meters which he expects his model to attain. The RSO shall record this anticipated altitude for each contestant.
- 41.10 Each entry must make a safe, stable flight, and only one official flight shall be available for this purpose. If the entry does not make a safe, stable flight, it shall be disqualified. In the event of a **catastrophic failure**, Rule 11.5 shall apply, and the contestant shall receive no penalties for rescheduling.
- 41.11 Each contestant shall set up his launcher, ignition system, and entry in the launching area to which he was assigned. His complete system, as ready for launching, must be inspected by the RSO or his deputy. An entry shall be allowed to fly only after it has received safety clearance from the RSO or his deputy.
- 41.12 The contestant must request a range clearance no later than sixty seconds prior to his T-time. The request for range clearance constitutes a commitment on the part of the contestant that he is ready to launch. If the request for range clearance is not made in the prescribed time, the contestants T-time shall be rescheduled by the RSO and the contestant shall be penalized 100 Space System points.
- 41.13 If a contestant experiences system difficulties prior to his T-time and before he has requested range clearance, he may

request a rescheduling of his T-time from the RSO. Each such request shall result in a penalty to the contestant of 25 Space Systems points.

- 41.14 The entry must be launched between the assigned T-time and T+3 minutes (the "launch window"). If the entry is launched outside of the launch window, it shall be disqualified. If the launch window expires and the model has not been launched, the contestant T-time shall be rescheduled by the RSO and the contestant shall be penalized 100 Space System points.
- 41.15 If the altitude tracking equipment is not ready within the contestants launch window, the contestant may request that the RSO reschedule his T-time. In this case, no penalty shall be assessed. At the contestants choice, he may also elect not to reschedule, in which case his entry shall receive a "track lost" score.
- 41.16 Each entry shall be tracked for achieved altitude.
- 41.17 If the entry does not land on or within the boundaries of the prescribed Safe Recovery Area, the contestant shall be penalized 250 Space Systems Points.
- 41.18 Space Systems Competition shall be scored as follows: the static scores awarded to the scale model rocket and the scale launching complex (if present) shall be summed, and the sum multiplied by 0.75. This result shall be added to the altitude of the model as tracked and reduced. An "altitude prediction accuracy factor" shall be computed according to Rule 20.8 and subtracted from the total. Finally, any penalties incurred by the contestant shall be deducted from the result. The contestant with the highest score thus achieved shall be declared the winner.
- 41.19 The Weighting Factor for Space Systems Competition is 16.
- 41.20 Any model that cannot be returned to the officials shall be disqualified. Rule 10.4 does not apply.

42. PLASTIC MODEL CONVERSION COMPETITION

- 42.1 Plastic Model Conversion Competition comprises a single event open to model rockets that have been assembled from commercially-available plastic model kits of guided missiles, rocket vehicles, space vehicles, or jets whose engines are on or enclosed in the fuselage. The model must be one that the manufacturer did not produce as a model to be flown; and it must be modified for safe and stable flight by the contestant.
- 42.2 The purpose of this competition is to produce a flying model from a kit originally intended as a static model; that shows maximum craftsmanship in construction, finish, and flight performance. The entry must be representative of the kit chosen, as designed by the manufacturer. It is not the purpose of this competition to allow entries which represent original and/or imaginative designs on the part of the contestant that incidentally are executed using parts from plastic kits as a basis.
- 42.3 With the exception of modifications necessary to convert the model for flight, the basic structure and configuration of the model must be as designed by the manufacturer of the kit. Details may be constructed from parts obtained from other commercially-available plastic kits, and from standard commercially-available plastic sheet, tubing, or shapes. Parts and assemblies necessary to convert the model for flight may be made of any safe material, and may be obtained from any source.
- 42.4 For stability purposes, the model may be fitted with transparent plastic fins to make it stable in flight. However, the transparent fins and their attachment shall be judged for craftsmanship along with the model.
- 42.5 The NAR number required to be on the model by Rule 9.3 shall be judged for craftsmanship along with the model.
- 42.6 Models shall be judged for static points in flight condition, with the exception that engine(s) and recovery system need not be present. Any clear plastic fins, launching lugs and fittings, and other exterior flight items must be attached to the model during scale judging. If they are not, the entry shall be disqualified. Nothing may be added to the model, or taken off the exterior of the model, between static judging and flight; except the engine(s) and recovery system(s).
- 42.7 Each entry must make a safe, stable flight, and only one official flight shall be available for this purpose. If the entry does not make a safe, stable flight, it shall be disqualified.
- 42.8 No human intervention (e.g., catching the model or cushioning its landing) shall be allowed between launch and touchdown. If the model is not allowed to fly and land naturally, it shall be disqualified. However, in circumstances where there is an extraordinarily high probability of damage to models allowed to land naturally (e.g., rocky terrain or adjacent bodies of water downwind) the Contest Director may suspend this rule and permit contestants to catch their models. In this case, models which are caught shall be judged as if they had sustained maximum damage on landing, but shall not be disqualified. This rule shall not be interpreted as disallowing remotely controlled or remotely guided models.
- 42.9 Static points shall be awarded according to the following schedule:
 - 42.9.1 Craftsmanship: 500 points.
 Points will be awarded in the following categories:
 - (a) Neatness and care in construction: 150 points.
 - (b) Craftsmanship of details: 100 points.
 - (c) Degree and quality of finish: 100 points.
 - (d) General appearance: 150 points.

- 42.9.2 Degree of Difficulty: 300 points.
Points shall be awarded according to the difficulty experienced by the modeler in building the model, according to the following schedule:
- (a) Asymetries inherent in the model: 40 points.
 - (b) Intricacy of paint pattern: 80 points.
 - (c) Degree of detailing required: 80 points.
- This category includes such items as the number of external components and details that had to be added or reconstructed individually by the contestant.
- (d) Difficulty of stabilizing model: 50 points.
 - (e) Difficulty of adapting model for flight: 50 points.
- The Judges should consider that entries exhibiting an equal level of craftsmanship may have required unequal amounts of time and effort because of the uniqueness of the kit chosen. (To facilitate judging, the contestant should point out difficult assemblies or construction problems in a note to the Judges.)
- 42.10 Flight points shall be awarded according to the following schedule:
- 42.10.1 Flight Characteristics: 200 points.
Flight Characteristics points are awarded for proper operation of the model during flight, according to the following schedule:
- (a) Launch (including misfires): 10 points.
 - (b) Stability: 100 points.
 - (c) Staging (if applicable): 10 points.
 - (d) Recovery: 30 points.
 - (e) Lack of damage on landing: 50 points.
- 42.11 Plastic Model Conversion Competition shall be scored as follows: the points awarded to the entry in static judging shall be added to the points awarded to the entry in flight. The contestant receiving the highest score is the winner.
- 42.12 The Weighting Factor for Plastic Model Conversion Competition is 10.
- 42.13 The model is not required to be returned to the Judges, except as stated in Rule 9.12. However, any model not returned shall be judged as if it had sustained maximum damage on landing.

MISCELLANEOUS EVENTS AND AWARDS

43. SPOT LANDING COMPETITION

- 43.1 Spot Landing Competition comprises three events open to single-staged entries of no more than 85 grams **gross launching mass**, and powered by an engine of not more than 10.0 Newton-seconds of total impulse.
- 43.2 The purpose of this competition is to land the entry so that the tip of its nose cone is closest to a predetermined spot on the ground.
- 43.3 The entry may not be remotely controlled or remotely guided.
- 43.4 Each entry must deploy its recovery device fully and completely before touching the ground. Each entry must comply fully with the provisions of Rule 3.5.
- 43.5 An entry must not separate into two or more unattached pieces.
- 43.6 Each entry shall be allowed only one official flight.
- 43.7 Spot Landing Competition shall be scored as follows: the distance between the nose cone of the model and the target spot shall be measured by the officials. If the tip of the nose cone lands more than 50 meters from the spot, the model shall be given a score of 50; otherwise, the model shall be given a score equal to its distance in meters. The contestant achieving the smallest score shall be the winner.
- 43.8 Spot Landing Competition shall be divided into three classes:
- 43.8.1 Parachute Spot Landing: Each entry must deploy a parachute, with dimensions no less than 15 centimeters square or 15 centimeters in diameter for recovery purposes; and attached to the nose cone.
 - 43.8.2 Streamer Spot Landing: Each entry must deploy a streamer with dimensions not less than 25 millimeters by 300 millimeters; and attached to the nose cone.
 - 43.8.3 Open Spot Landing: Any type of recovery device is allowed, provided it conforms to the provisions of Rule 3.5.
- 43.9 The Weighting Factor for Spot Landing Competition is 2.
- 43.10 Any model that cannot be returned to the officials shall be disqualified. Rule 10.4 does not apply.

44. QUADRATHON AWARD

- 44.1 The Quadrathon Award is a special award of contest points given to the contestant achieving the best overall performance with a single model in a specific series of events, during the course of a single Meet.

- 44.2 The purpose of this Award is to recognize modelers who successfully cope with the problems encountered in excelling in four dissimilar events with a model of general utility and compromise design.
- 44.3 The Quadrathon Award may be offered at any Meet, provided that:
- (a) The Contest Director of the Meet has expressed an intention on the "Application for Contest Sanction" to grant the award;
 - (b) The Contest Director has applied to hold the four events comprising the basis of the Quadrathon Award; and
 - (c) The four events comprising the basis for the Award are held within a time frame of no more than two consecutive days during the course of the Meet.
- 44.4 Any contestant shall be eligible for the Quadrathon Award, provided that:
- (a) The contestant has expressed to the Meet officials his intent to attempt to qualify for the Quadrathon Award on his contest entry form; and
 - (b) The contestant makes at least one official flight in each of the four prescribed events with the same model.
- 44.5 The four event categories comprising the basis for the Quadrathon Award are the following:
- | | |
|----------------------------|---------------------------|
| Class A Parachute Duration | Class A Streamer Duration |
| Class B Payload | Streamer Spot Landing |
- 44.6 Where more than one flight is permitted by the rules of one of the four events (i.e., in all events except Spot Landing) the contestant has the option of flying either one or both of the flights with his Quadrathon model. If the Quadrathon model is used for only one flight of the event, the score received in that flight shall be applied towards the contestant's Quadrathon score. If the Quadrathon model is used for both flights of the event, the better of the two scores received shall be applied towards the contestant's Quadrathon score. This rule shall not be interpreted to affect or modify the normal computation of scores for the individual events, which shall be computed as usual, and be the basis for separate awards in these events.
- 44.7 A disqualification in Spot Landing shall not disqualify a contestant from eligibility for the Quadrathon Award. Instead, a penalty distance of 100 meters shall be entered as the contestant's score in Spot Landing, for purposes of the Quadrathon Award only. This rule shall not be interpreted to affect or modify the standing of the contestant in the individual Spot Landing event, in which the disqualification shall stand.
- 44.8 A disqualification in Parachute Duration, Streamer Duration, or Payload shall not disqualify a contestant from eligibility for the Quadrathon Award. Instead, a penalty score of zero shall be entered as the contestant's score for the disqualified flight.
- 44.9 The recovery system of the model may be changed from streamer to parachute, or vice versa. The model need not carry the payload on any flight where it is not otherwise required.
- 44.10 A model which becomes damaged may be repaired by the contestant under the provisions of Rule 9.7, provided that the repairs can be made in time for the model to complete the required events within the prescribed time.
- 44.11 If a **catastrophic failure** irreparably damages the model during any Quadrathon-eligible flight, the contestant shall be permitted to substitute an identical model for the purpose of completing the remaining flights.
- 44.12 It is the responsibility of the officials to ensure that the model entered in each Quadrathon-eligible flight by a contestant is the same model.
- 44.13 It is the responsibility of the contestant to ensure that his flight record for each Quadrathon-eligible flight is properly marked so as to indicate to the officials that it is a Quadrathon flight attempt.
- 44.14 Figures of merit for the Quadrathon Award shall be computed as follows: the durations achieved in seconds in Parachute Duration and streamer Duration shall be added to the altitude in meters achieved in Payload. The distance achieved in Spot Landing shall be subtracted from this sum. The entry with the highest score thus obtained is the winner. First- through fourth-place awards shall be granted.
- 44.15 The Weighting Factor for the Quadrathon Award is 7.
- 44.16 All Quadrathon-eligible flights must be returned to the officials. Rule 10.4 does not apply.

45. DRAG RACE COMPETITION

- 45.1 Drag Race Competition comprises a single event open to single-staged entries of no more than 85 grams **gross launching mass**, and powered by an engine of not more than 10.0 Newton-seconds of total impulse.
- 45.2 The purpose of this competition is to determine which entry is most successful at meeting the triple criteria of quick ignition and lift-off, low altitude, and long duration.
- 45.3 The event is a series of flyoffs (heats) between pairs of entries. The winner of each heat flies against the winner of another heat until the overall winner is determined.
- 45.4 No substitution of models is permitted during the course of this event, except as specified under the provisions of Rule 11.5.
- 45.5 Competitors for each flyoff shall be chosen by the officials by lot.
- 45.6 The model may be launched by either of the following methods:
- (a) through a common ignition switch operated by the Launch Control Officer; or

- (b) by the contestants themselves, using separate ignition systems.
- 45.7 Any type of electrically-initiated ignition system may be used, provided that it meets the requirements of Rule 9.4.
- 45.8 An entry which does not fly successfully shall be disqualified.
- 45.9 When a model is launched with a separate ignition system under the control of the contestant, the model must achieve first motion on or after T-O. A model achieving first motion before T-O shall be disqualified.
- 45.10 A model which does not achieve first motion before T+2 shall be disqualified.
- 45.11 Drag Race Competition shall be scored as follows: the winner of each heat shall be that entry which receives the highest number of points according to the following schedule: (a) One point for the first entry to achieve first motion; (b) One point for the entry achieving the lowest altitude; and (c) One point for the entry that touches the ground last. If the entry separates into two or more pieces, the first piece to touch the ground is counted. The winner of the last heat shall be declared the winner.
- 45.12 Only first and second places shall be awarded in this event.
- 45.13 The Weighting Factor for Drag Race Competition is 1.
- 45.14 The model is not required to be returned to the officials, except as stated in Rule 9.12.

46. RESEARCH AND DEVELOPMENT COMPETITION

- 46.1 Research and Development Competition is open to any NAR member who is performing research, or engineering new developments, in which model rocketry plays a primary part.
- 46.2 The purpose of this competition is to stimulate new concepts, approaches, and ideas in:
 - (a) advancing the state-of-the-art of model rocketry; or
 - (b) using model rocketry as a research tool.
- 46.3 This event may be conducted at Conventions as well as at Competition Meets. A Convention director desiring to hold Research and Development Competition shall apply for a contest sanction as described in Rule 6.8. The Convention shall be sanctioned as a Section Meet, with a Contest Factor of 1.
- 46.4 This competition may not be conducted by proxy, unless the Contest Director rules that special circumstances, such as illness, warrant special consideration.
- 46.5 Each entry in this competition shall be judged by three Judges, who shall be selected by the Contest Director. Although NAR membership is not a prerequisite for judging, all Judges must demonstrate a working knowledge of the rules of the competition, and be technically competent to judge the quality of the entries.
- 46.6 Each entry must be accompanied by a written report, stating in detail:
 - (a) The objectives of the work;
 - (b) The approach taken;
 - (c) The equipment used;
 - (d) The data collected;
 - (e) The results obtained; and
 - (f) The conclusions drawn and/or plans for further work.
- 46.7 Each entry shall include, in addition to the detailed report, a separate 250- 300-word written summary of the report. The summaries from all the entries shall be sent to the NAR Contest Board by the Contest Director with the meet results. The NAR reserves the right to publish the summary in order to disseminate information on current R&D activities. This in no way is intended to interfere with the contestant's right to publish his report or summary.
- 46.8 The contestant should be prepared, if called upon by the Judges, to make an oral presentation on his project. The oral presentation shall not exceed fifteen minutes. The presentation should cover briefly the material of the written report. During this presentation, the contestant shall not be interrupted. No oral comments shall be made by anyone until the presentation is complete and the contestant asks for questions. At this time, the Judges and members of the audience may question the contestant concerning his project for a time not to exceed ten minutes.
- 46.9 An oral presentation shall be required from those contestants being considered for the top places.
- 46.10 If required, the contestant must demonstrate his project in operation. Success or failure of the demonstration shall not affect the contestant's score, provided that the contestant gives a reasonable oral explanation of the deviation from expected performance.
- 46.11 If any entry does not fully comply with the safety standards set forth in this NAR Sporting Code, the contestant must present to the RSO adequate evidence that the entry is reasonably safe in operation. The RSO is the only official who may judge the safety qualities of a project.
- 46.12 The Contest Director may place a financial limit on the total expenses that a contestant may incur in the development of the project. This limit must accompany the announcement of the competition. Whether or not this limit is imposed, the contestant must state in his written, report how much money was spent on the project, and what facilities were available to him to carry out experimental work.
- 46.13 Research and Development competition shall be scored as follows: on the basis of the quality of the projects submitted, places may be awarded or withheld at the discretion of the Judges. No ties shall be awarded in any place.
- 46.14 The Weighting Factor for Research and Development Competition is 17.

WEIGHTING FACTOR CHART

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Altitude																				
Altitude Efficiency				D	E			F												
Parachute Duration				1/4 A to A	B to C		C													
Payload					1/4 A to C	D & E	F													
Streamer Duration					1/4 A to A	B & C	D & E	F												
Egg Lofting Duration						C & D	B & E	F												
Egg Lofting Altitude							C & D	B & E	F											
Super-Roc Altitude							A to C	D	E		F									
International Parachute Dur.								1/4 A to A	B & C											
International Streamer Dur.								1/4 A to A	B & C	D & E	F									
Helicopter Duration								A & B	1/4 A, 1/4 B, & C	D to F										
Super-Roc Duration								A to C	D	E		F								
Boost/Glider Duration									1/4 A to B	1/4 A & C	D	E	F							
International B/G Duration										1/4 A to B	1/4 A & C	D	E	F						
Rocket/Glider Duration										1/4 A, B, & C	1/4 A & A	1/4 A, B, & C	D	E	F					
Scale Altitude														1/4 A to A	B to D	E & F				
Drag Race																				
Spot Landing																				
Design Efficiency																				
Predicted Altitude																				
Predicted Duration																				
Quadrathon																				
Plastic Model																				
Sport Scale																				
Scale																				
Space Systems																				
R & D																				
Super Scale																				

Maximum Weighting Factors:

Section Meet: 45
 Open Meet: 57
 Regional Meet: 66

GLOSSARY

catastrophic failure: A malfunction of the engine, or a failure which, in the opinion of the judges, is not due to or caused by improper design, construction, or preflight preparations of the model. A flight experiencing a catastrophic failure can be declared to be not an official flight. See Rule 11.5.

construction: The action required to complete a model starting with no more prefabrication than the amount used in the average kit. Model rockets that are completely prefabricated and require only a few minutes of unskilled effort for their completion, or in which many normally separate pieces are preassembled (e.g., one piece fin units) are not considered to require construction.

contestant: A NAR member or a team composed of NAR members entered in a sanctioned competition.

first motion: The instant at which a model begins to move upward under the thrust provided by a model rocket engine.

gross launching mass: The mass of a model rocket in flight condition, including fully-loaded engine; but not including launching devices or auxiliary equipment which does not become airborne with the model.

misfire: Failure of a model to make an official flight when its launch is attempted; or, failure of an entry, after being safety-checked, to be ready for launch when its turn has come. Failure to launch caused by a malfunction in a meet-provided launch system shall not be considered a misfire.

NAR Contest Board: Refers to the National Contest Board of the National Association of Rocketry. If a rule applies to action with respect to a Regional Contest Board, this is specifically stated.

pitch axis: An imaginary reference line through a model about which the model might rotate. On a typical model rocket, this axis runs "sideways" through the body at the center of gravity. Since a model rocket is usually symmetrical around the roll axis, the pitch and yaw axes are usually indistinguishable. On a typical glider, the pitch axis runs "sideways" through the fuselage or "boom" in such a manner that if the model, during gliding flight, were to rotate about the pitch axis, its nose would move up or down.

roll axis: An imaginary reference line through a model about which the model may rotate without changing its direction of travel. On a typical model rocket this axis runs down the length of the model, from the center of the nose cone through the center of the engine nozzle. On a typical glider, it runs down the fuselage or "boom," from the nose to the tail.

safety ruling: A ruling by the RSO, a deputy RSO, or (in limited cases according to Rule 11.1) the Contest Jury, denying an entry the opportunity to fly due to considered judgement that the model would be unsafe in flight; also a ruling that disqualifies a model which flies in an unsafe manner. If an RSO or deputy RSO, acting in the capacity of a flight judge, disqualifies a model for a reason other than unsafe or hazardous operation or flight, this is not considered a safety ruling.

stage: Any portion or portions of the model airframe containing one or more model rocket engines designed to separate or which actually separate(s) from the model at the same time while in flight. An unpowered portion of the model is not considered a stage.

yaw axis: An imaginary reference line through a model about which the model might rotate. On a typical model rocket, this axis runs "sideways" through the body at the center of gravity (see "pitch axis"). On a typical glider, the yaw axis runs "sideways" through the fuselage or "boom" in such a manner that if the model, during gliding flight, were to rotate about the yaw axis, its nose would move left or right.

CAP MODEL ROCKET LAUNCHING DATA SHEET				
NAME		GRADE		CAP SERIAL NUMBER
SQUADRON	CHARTER NUMBER		WING	
PERSONNEL PARTICIPATING				
RANGE OFFICER		SAFETY OFFICER		
LAUNCH SUPERVISOR		OTHERS		
WEATHER DATA				
TEMPERATURE	WIND DIRECTION	WIND VELOCITY	VISIBILITY	CEILING
MODEL ROCKET DATA				
NAME AND/OR MODEL NO.		DIMENSIONS		
NUMBER & TYPE OF FINS	MOTOR		TOTAL WEIGHT	
EXPECTED PERFORMANCE				
TOTAL FLIGHT TIME	MAXIMUM ALTITUDE		AVERAGE VELOCITY	
LAUNCHING DATA				
LOCATION OF LAUNCH SITE		TYPE LAUNCHER		
LAUNCHING ANGLE		DATE AND TIME OF LAUNCHING		
<div style="display: flex; justify-content: space-between;"> <div> MISFIRE SUCCESSFUL FIRING TAKEOFF NORMAL PART FAILURE </div> <div> <input type="checkbox"/> YES <input type="checkbox"/> NO (IF YES, GIVE REASON AND CORRECTIVE ACTION TAKEN IN REMARKS.) <input type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, EXPLAIN IN REMARKS.) <input type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, EXPLAIN IN REMARKS.) <input type="checkbox"/> YES <input type="checkbox"/> NO (IF YES, EXPLAIN IN REMARKS.) </div> </div>				
TOTAL FLIGHT TIME	ESTIMATED MAXIMUM ALTITUDE		ESTIMATED AVERAGE VELOCITY	
IMPACT DISTANCE	FLIGHT BEHAVIOR		OTHER	
REMARKS (USE REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED)				

Select Model Rocketry References and Sources

I: BASIC PROGRAM

1. *Aerospace Education and Model Rocketry*. Penrose, CO: Estes Industries. (A comprehensive teacher's guide for introducing model rocketry and starting a model rocketry program. Step-by-step guidance, suggested activities, a bibliography, and more. 36 pages.)
2. *Alpha Book of Model Rocketry*. Penrose, CO: Estes Industries. (The ideal "first book" for beginners in model rocketry. Includes a Flight Data Sheet to record the first four missions. 32 pages.)
3. *Camp Leader's Model Rocketry Manual*. Penrose, CO: Estes Industries. (Guide for introducing model rocketry successfully into camp programs. 10 pages.)
4. Cannon, Bob and Mike Banks. *The Rocket Book*, Prentice-Hall, 1987. (A useful guide for teachers and club leaders to use in model rocketry.)
5. *Estes Catalog*. Penrose, CO: Estes Industries. (Current Estes catalog of model rocket products. Available to teachers and recognized youth group leaders at nominal cost for distribution to their students or group members.)
6. *Model Rocketry Study Guide*. (Technical Report that presents a logical program for students in model rocketry. Goes through three skill levels. Has a glossary and self-test for each section and a final exam is provided for those who wish to qualify for the Estes Expert Rocketeer Award. TR-8.)
7. *Recro-Recreational Program*. Penrose, CO: Estes Industries. (Excellent guide for starting a community program in model rocketry.)
8. Stine, G. Harry. *The Handbook of Model Rocketry*, sixth ed. Arco Publishing Co., 1983. (Excellent manual for all model rocketry activities. Contains a model rocketry computer program written in BASIC.)
9. Visual Aids: See Section II.H. Film and Filmstrips.

II: ADVANCED PROGRAMS

A. Model Rocketry Topics

1. *Countdown: Mathematics and Model Rocketry*. Penrose, CO: Estes Industries. (Teacher's guide shows how to incorporate hands-on learning activities into math curriculum. Provides a variety of learning experiences at three levels from middle school through high school.)
2. Eagle, David. *Rocket1*. David Eagle, 3759 76th St., SW, Byron Center MI 49315. (A computer program that determines the flight performance of a model rocket using an analytical or "exact" solution. Solves the problem of vertical motion of a model rocket using certain approximations which allow direct integration of the equation of motion.)
3. Eagle, David. *Rocket 2*. David Eagle, 3759 76th St., SW, Byron Center MI 49315. (A computer program which determines the flight performance of a model rocket. Solves the problem of nonvertical motion. User can specify launch angle. Program integrates the two-dimensional equations of motion.)
4. *Elementary Mathematics of Model Rocket Flight*. Penrose, CO: Estes Industries. (Technical Notes TN-5. How to make and use your own altitude tracker and how to calculate speed and accelerations reached by model rockets.)
5. *Estes Guide for Aerospace Clubs*. Penrose, CO: Estes Industries. (Source book for organizing and operating model rocket clubs or EAC Chapter. Reference for organization and activities. 34 pages.)
6. *Industrial Arts Teachers Manual for Model Rocketry*. Penrose, CO: Estes Industries. (Practical 52-page guide on basic model rocketry and its unique applications in the study of manufacturing, transportation, R&D, communication, and construction.)
7. *Model Rocket Launch Systems*. Penrose, CO: Estes Industries. (Photographs and clearly drawn schematics. The electrical theory of launchers is explained, and a number of special study problems are included. 20 pages.)

8. *Space Age Technology*. Comprehensive textbook on man's achievements in rockets for space missions. Illustrated. Teacher's Manual available to teachers and adult leaders only.

9. Stine, G. Harry. "The Formative Years of Model Rocketry, 1957 to 1962: A Personal Memoir," XXVII Congress, *International Astronautical Federation*. Los Angeles: October 1976. Insight into the development of model rocketry.

10. *The Laws of Motion and Model Rocketry*. Penrose, CO: Estes Industries. (The three laws of motion are explained in terms which most students of eleven years of age or older can understand. Examples and experiments. A self-test is provided for each law with answers. 12 pages.)

B. Technical Reports and Notes

1. *Aerodynamic Drag of Model Rockets*. Penrose, CO: Estes Industries. (Gives practical examples of ways to minimize aerodynamic drag and improve performance. TR-11.)

2. *Altitude Prediction Charts* Penrose, CO: Estes Industries. (Explains a relatively simple method by which aerodynamic drag and other atmospheric effects can be taken into account in predicting rocket peak altitudes. Suggestions for research projects. TR-10.)

3. *Altitude Tracking*. Penrose, CO: Estes Industries. (Explains simple altitude tracking of model rockets. Basic tracking and altitude computations. TR-3.)

4. *Cluster Techniques* Penrose, CO: Estes Industries. (Report on clustering engines in model rockets. Essential for the modeler who wishes to loft larger payloads. TR-6.)

5. *Front Engine Boost Gliders* Penrose, CO: Estes Industries. (Designing, building, and flying front engine boost gliders. Fully illustrated. TR-7.)

6. *Is That Parachute Too Big?* Penrose, CO: Estes Industries. (Discusses techniques to speed descent rates of parachutes but yet prevent damage to rockets. TN-3.)

7. *Model Rocket Engines* Penrose, CO: Estes Industries. (Information on engine types, classifications, design, and performance. TN-1.)

8. *Model Rocket Engine Performance*. Penrose, CO: Estes Industries. (Explains the operation of model rocket engines. Contains equations for calculating engine performance. TN-2.)

9. *Muльти-staging*. Penrose, CO: Estes Industries. (Reveals latest in multi-staging techniques. A necessity for designing, building, and flying multi-stage rockets. TR-2.)

10. *Rear Engine Boost Gliders*. Penrose, CO: Estes Industries. (Basic information for the design and operation of rear engine boost gliders. Covers construction techniques and glide characteristics. TR-4.)

11. *Recovery Techniques*. Penrose, CO: Estes Industries. (Theory and practical applications for each of the recovery systems. TN-6.)

12. *Rocket Stability*. Penrose, CO: Estes Industries. (All about rocket stability. Contains before-launch tests to assure rocket stability. TR-1.)

13. *The Fine Art of Payload Launching*. Penrose, CO: Estes Industries. (Information on payload launching with data on possible payloads, available payload compartments, and suggestions on preparation and launch of payloads. TN-4.)

C. Reporting Journals and Articles

1. Estes Industries. *Educator News*. Penrose, CO: Estes Industries.

2. Estes Industries. *Model Rocket News* Penrose, CO: Estes Industries.

3. Estes Industries. *Model Rocketry Library Collection*. Penrose, CO: Estes Industries. (Copies of virtually every Estes publication. An excellent reference on all aspects of model rocketry.)

4. LOC/Precision. *Model Builder*. 1042 Sroquois, Macedonia, Ohio 44056. (Current information on all areas of model building, including rocketry.)

5. National Association of Rocketry. *American Spacemodeling*. Elizabeth, PA: National Association of Rocketry, 182 Madison Drive, Elizabeth, PA 15037. (Official journal of the NAR; updated information on the NAR Safety Code and other items of interest to model rocketeers.)

6. National Association of Rocketry. *Model Aviation Magazine*. NAR, 182 Madison Drive, Elizabeth, PA 15037. (Covers every aspect of the hobby of model aircraft and rockets.)

7. Stine, G. Harry. "Build Your Own Spaceship," *Starlog*. March, 1979.

8. Stine, G. Harry. "Model Rocketry for Computer Hobbyists," *Personal Computing*, November 1978.

9. Stine, G. Harry. "The Long Road to Lakehurst," Official Program, World Space Modeling Championships, Lakehurst, NJ, September 7-12, 1980.

10. Stine, G. Harry. "The Old Rocketeer," *Model Rocketeer*. Elizabeth, PA: National Association of Rocketry. (Regular monthly column on model rocketry, December 1976 through February 1978.)

11. Stine, G. Harry. "The Non-Professional Side of Astronautics," *AIAA Student Journal* 4 April 1973.

D. Further Reading

1. Civil Air Patrol. *Dr. Robert H. Goddard*. (A highly acclaimed teaching/learning packet for classroom or home use. Contains a vast assortment of unit instructional materials and exciting learning experiences.)

2. Kirk, Douglas. *Yearning to Understand* Morton Falls Publishing Company, 1987. (A book which provides an enormous amount of information about the past 30 years of the U.S. space effort.)

3. Quackenbush, Robert. *The Boy Who Dreamed of Rockets*. Parents' Magazine Press, 1978. (A book on the life of American rocket expert, Robert Goddard.)

E. Projects

1. *Altitude Prediction Charts*. Penrose, CO: Estes Industries. (Includes suggestions for research projects. TN-10.)

2. *Building a Wind Tunnel* Penrose, CO: Estes Industries. (Full plans and information for building a simple wind tunnel to study rocket stability. Covers motor and handpowered vehicles, checking multi-stage rockets, etc. For advanced rocketeers. TR-5.)

3. *Projects in Model Rocketry*. Penrose, CO: Estes Industries. (Suggestions on how to plan, prepare, and present research projects. Ideas for about one hundred projects ranging from simple exhibits to true research work. 12 pages.)

F. Course Guides (Syllabus for teaching model rocketry or for using model rocketry in a science class.)

Grades 4-6, Dr. Herbert Simmons (Author), Western Kentucky University.

Grades 6-9, Dr. Gary Downs (Author), Iowa State University.

Grades 9-12, Mr. Roger Grossenbacher, Lancaster (OH) High School.

For more information, direct your inquiry to: Course Guides
Estes Industries
1295 H Street
Penrose CO 81240

G. Computer Software - Estes Industries
1295 H Street
Penrose CO 81240

1. *Flight. Aerodynamics of Model Rockets*. (Explores topics of forces on flying objects, center of gravity, center of pressure, stability, and aerodynamics.)

2. *In Search of Space: Introduction to Model Rocketry*. (Explains the basics of model rocketry. Disc deals with model rocket flight profile, parts, engines, safety code, and classifications.)

H. Film and Filmstrips

1. Estes Industries. *Rockets!* Penrose, CO: Estes Industries. (A full-color, sound-on-cassette filmstrip produced by Jim Ciletti of Omega. Introduces model rocketry. Good for Basic Program and AE workshops for rocketry program instructors. #1499. 12 minutes.)

2. Obern, Vaughn. *Model Rocketry. The Last Frontier*. Santa Monica, CA: Vaughn Obern, 704 Santa Monica Blvd., Santa Monica, CA 90401 or loaned from Modern Talking Picture Service, Box 33002, St. Petersburg FL 33733. (Color, 16mm, 15-minute movie on model rocketry. Good for Basic Program and AE workshops for rocketry program instructors.)

I. Aerospace Education Workshops on Model Rocketry

1. Estes Industries. *ALPHA II*. Penrose, CO: Estes Industries. (A special version of the Estes Alpha Kit. It can be built rapidly and includes glue, sandpaper, and razor blade. Included is a teacher's guide. Kit is available only for teacher training workshops and is not for sale to classroom teachers for purchase for their students. One launch system is recommended for each 15 workshop participants. #1421.)

2. Films: See H. Films and Filmstrips above.

3. Other Products: See BASIC PROGRAM, number S.

J. Visual Aids: See D.1 and H. Film and Filmstrips.